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DESCRIPTIVE CATALOGUE OF SPECIMENS IN THE HOSPITAL MUSEUM.

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SERIES I.—INJURIES OF THE EYE.

Subseries (A).—*Concussions.*

Under this heading are included eyes which have been injured by blows from blunt objects, and in which there has been no penetrating wound, or where the wound has been small and not the most obvious lesion. The changes which are shown are due to displacement of parts or to tearing of some of the internal structures.

Hæmorrhage into the anterior chamber may be slight, a small quantity of blood collecting at its lower part forming an hyphœma (Nos. 19, 25); or extensive, filling it entirely (No. 16), sometimes even forcing backwards the iris and lens (Nos. 5, 20). When very extensive, discoloration of the cornea may take place (Nos. 5, 16, 20). This discoloration is found microscopically to be due to the diffusion of a number of

minute, highly refracting granules throughout the corneal tissue. Clinically, the cornea is seen to be of a greenish-brown hue. The extreme periphery is usually unstained, the stained part ending by a sharply-defined margin. The appearance may simulate very closely that of a lens dislocated into the anterior chamber (No. 16). The blood generally comes from the ruptured vessels of the iris or from the ciliary processes, in the latter case being effused into the posterior chamber and passing forwards through the pupil.

A blunt object striking the cornea will force it inwards, its posterior surface approximating the lens, and the aqueous being displaced laterally, so that the force of the blow is felt at the periphery of the anterior chamber as well as directly backwards. In such cases the iris may become torn from its attachment to the ciliary body, producing the condition termed *iridodialysis* (No. 31. See Fig. 2). A separation of this sort occasionally becomes closed by fibrous tissue (No. 23). In other cases in which a similar injury is inflicted, the fibres of the ligamentum pectinatum which curve round the angle of the anterior chamber to go to the root of the iris rupture, and the ciliary muscle splits, the angle of the chamber being prolonged outwards (Nos. 7, 13, and 31 ; Fig. 2), or the whole of the ligamentum pectinatum ruptures and the ciliary muscle is torn from the sclerotic (No. 19).

After blows on the eye, occasionally a part or the whole of the iris disappears from view clinically. When only a part has disappeared immediately after the injury, it is due to rupture of the ligamentum pectinatum having allowed of its retraction beyond the sclero-corneal margin (No. 19). When some time has elapsed between the receipt of the blow and the disappearance of the iris, its tissue is found to have become much shrunken (Nos. 24, 25), probably as the result of great pressure of its root against the posterior surface of the cornea causing constriction of its vascular supply. This shrinking affects the

anterior layers, *i.e.*, the stroma, more than the uveal pigment on its posterior surface; consequently this latter is found to turn round the tip of the iris, so-called ectropion of the uveal pigment.

A cataractous condition of the lens following a concussion of the eye (Nos. 1, 7, 13, 19, and 31) might possibly be due to one of two causes; nutritive disturbance, or rupture of its capsule and exposure of its substance to the action of the aqueous humour. In several cases rupture of the capsule has been found, and so far no well authenticated case has been recorded in which it could be proved that the capsule was completely intact. Dislocated lenses, however, frequently become cataractous and calcareous (Nos. 3, 9, 18, 21, 26, and 28). The most usual place for the lens capsule to rupture is at its equator. It may rupture at its posterior pole (No. 22), in which case the lens substance is exposed to the vitreous, and not to the aqueous, and may remain clear for some days. When exposed to the action of the aqueous, complete absorption is possible without any of its contents having escaped through a perforating wound (No. 10).

What is more common than rupture of the capsule, and what frequently accompanies it, is rupture of all or some of the fibres of the suspensory ligament, and consequent displacement of the lens. This displacement varies in extent and in direction. The lens is sometimes displaced forwards into the anterior chamber, either completely (Nos. 26, 28); or partially, one margin only projecting through the pupil (No. 4). One side of the suspensory ligament may alone be torn, lateral dislocation of the lens in the opposite direction resulting (See Fig. 1; Nos. 6, 7, 9, 18, 19, and 28); or, the whole of it being ruptured, the lens may be forced backwards into the vitreous chamber (Nos. 3, 11, 14, 15, 21, and 27).

Hæmorrhage into the vitreous may come from three possible sources:—(i.) From the ciliary body (No. 19); (ii.) from the retinal vessels (Nos. 13 and 31); (iii.) from the

choroid, provided there has been a rupture of it and the retina. There is no specimen in the collection showing a rupture of the choroid, but it is a comparatively frequent occurrence clinically. The vitreous sometimes becomes displaced as the result of concussions of the eye, its hyaloid being detached either posteriorly from the retina (Nos. 11 and 20), or antero-laterally from the suspensory ligament of the lens (No. 20). It occasionally protrudes forwards between the margin of a displaced lens and the ciliary body (Nos. 7, 19, 31), even passing in front of the iris into the anterior chamber (No. 29. See Fig. 1). Shrinking of it also occurs from disturbance of its nutrition.

Following on such displacement or shrinking of the vitreous, detachment of the retina is by no means uncommon (Nos. 1, 2, 5, 8, 10, 12, 13, 16, 17, 18, 19, 21, 24, 25, and 27).

Injuries to eyes in which there is no external wound seldom give rise to any severe inflammation, but the degeneration of the tissues which sometimes follows may predispose them to inflammatory processes should the necessary *materies morbi* be present.

Among the degenerations which ensue may be mentioned, calcareous changes in the lens (Nos. 15, 21, 26, 27, 28, and 30); atrophy of the tunica vasculosa (Nos. 24, 27, 28, 30); the formation of colloid nodules amongst the uveal pigment cells (Nos. 8 and 10); and the ingrowth of these nodules into the substance of the retina causing one form of retinal pigmentation (Nos. 8, 28, 30).

The retina also when detached for some years occasionally becomes cystic (Nos. 16, 17, and 18).

Increase or diminution of the normal tension may follow a concussion of the eye. The former is due to the alteration in the relative position of the lens and vitreous body, pressing forwards the root of the iris into contact with the filtration area of the cornea, or to the pupil becoming filled by a displaced lens so that fluids are

unable to pass through it from the posterior or the vitreous chambers into the anterior chamber. Diminution of tension is in some cases possibly due to enlargement of the angle of the anterior chamber, allowing a more rapid exit of fluids than usual (Nos. 7, 13, 19, and 31), and in others to arrest of secretion.

No. 1.—The two halves of an eye opened by an equatorial section mounted in one cell. It was injured four months previous to its excision, the accident being followed by immediate loss of sight, increased tension, and pain. The anterior chamber is shallow. The lens is opaque. The retina is detached everywhere from the optic disc up to the ora serrata; it is transparent and folded, but not much shrunken: there are some hæmorrhages and white spots in it. The vitreous is transparent but shrunken.

No. 2.—The outer half of an eye injured by repeated blows at different times. The retina is detached from the optic disc and contracted towards the back of the lens. Attached to its outer surface is a thick pillar of retinal tissue, which extends back to be inserted into the choroid about three lines external to and below the yellow spot. This pillar is thinnest in the middle and wider at each end, more so at the anterior where it passes into the contracted retina; at its choroidal insertion, the pigment epithelium is slightly drawn forwards. The vitreous is shrunken and fibrous. The iris is in contact with the cornea.

No. 3.—About two thirds of a left eye with a piece cut out of one side. Thirteen years previous to its removal it was injured by a blow from a fist. Sight was reduced to mere perception of light within two months. There had been occasional attacks of pain in it during the last two months. The tension was increased. The lens is opaque, yellow, and swollen; it is still in its capsule, but it has fallen back into the vitreous.

No. 4.—The front part of an injured eye. The lens, opaque and yellow, has one margin projecting forwards in front of the iris through the pupil into the anterior chamber. The other parts of the eye appeared healthy.

No. 5.—The two halves of an eye mounted in separate cells. It was injured by a blow, and at the time of excision the tension was increased. The cornea is blood-stained. The anterior chamber is filled by pale red blood clot, which has pushed back the iris and distended the chamber. The lens is absent. The retina is detached in an umbrella form from the optic disc up to the ora serrata; it is, moreover, torn from its attachment at the ora serrata as far forwards as the ciliary processes over about one-third of its circumference. In front of the retina are some blood-stained remnants of the vitreous. The ciliary processes and iris are covered by an opaque, probably fibrinous material.

No. 6.—The two halves of a left eye, divided transversely, mounted in separate cells. The patient received a blow on this eye three weeks before excision. At the date of excision the eye was quite blind, and the tension increased. In the front half of the globe the lens is seen to be displaced laterally, so that there is a space one-tenth inch wide between its margin and the pupillary edge. The suspensory ligament is torn on the side from which the lens has moved. In the hinder portion of the globe the optic disc is deeply cupped, but in other respects this part of the eye appears healthy.

No. 7.—The outer half of the eye of a boy, aged 6. Eight days previous to its removal it was struck by a stone from a catapult. There is a split in the ciliary muscle in its entire circumference which gives the appearance as though the angle of the anterior chamber had been prolonged outwards. Microscopically this split is seen to have passed across those fibres of the ligamentum pectinatum which pass to the base of the iris and to have separated the circular from the longitudinal fibres of the muscle. The lens is somewhat shrunken, opaque, and displaced upwards and backwards. Below, the fibres of the suspensory ligament are torn through, and the lens capsule ruptured. The vitreous is protruded forward between the lower margin of the lens and the ciliary processes. The anterior chamber is very deep.

(Recorded in Trans. Ophth. Soc., vol. xii, p. 183.)

No. 8.—The two halves of an eye from a patient, aged 56, which was injured by a blow. The tension at the time of

excision was increased. It has been opened by an antero-posterior section, and the two halves are in separate cells. It is considerably shrunken. The sclerotic is thickened. The anterior chamber is very shallow, the iris being pressed forwards almost in contact with the cornea. The lens is in its normal position and clear. One half of the retina has become detached from the choroid up to the ora serrata. There is extensive branching pigmentation of the undetached part, the lines of pigment corresponding to the retinal vessels. The uveal pigment layer lining the choroid is much thinned and probably has colloid nodules in it.

No. 9.—The two halves of an eye, divided by an equatorial section, of a man, aged 67, who twenty years previously had had it injured by a blow. Five weeks before excision it became inflamed and painful. The anterior half shows the semi-opaque, shrunken, and amber-coloured lens; it is displaced laterally, so as to leave uncovered nearly half the area of the pupil. The ciliary processes have become much atrophied, the area included within them is considerably larger than it should be. The iris is thinned in several spots, so that it transmits light at a number of places. All the other parts of the eye appear macroscopically to be healthy.

No. 10.—The lateral half of a left eye, from a man, aged 50, which sixteen years previously had been struck by a piece of round wood. It did not become quite blind until five years later, but had been frequently red and painful. The pain had been worse since a fresh blow a month before excision. It is shrunken, squared, and puckered, especially at the equator. The sclerotic is irregularly thickened. The iris is thin, devoid of pigment, and adherent to the lens capsule. The lens is absent, its capsule thickened and opaque. The retina is detached in the form of a hollow cone, with its apex at the optic disc; it is much shrunken. The subretinal space was filled with old blood clots, which have been removed. The uveal pigment shows much disturbance; there are a few commencing colloid nodules on the inner surface of the elastic lamina. The choroid is much atrophied.

No. 11.—The lower half of an eyeball divided just above the

level of the optic nerve of a man aged 66, who, seven weeks previous to its removal, was chopping wood, when a piece flew up, and struck his eye. He was unconscious for two hours after the blow; the piece that struck him had a sharp point at one end of it. He is uncertain if it entered the eye or not, but "it bled a little." The tension at the date of excision was +2. The lens is displaced outwards; its outer border projects forwards, and the inner one backwards. The iris is pushed in front of the outer border into contact with the cornea, and is much atrophied in this position. A localised prominence of the iris was thus caused, which was taken clinically to be a cyst of the iris. The angle of the anterior chamber is closed in its entire circumference. A membrane fills the pupil. The vitreous is shrunken and detached posteriorly. The retina is slightly detached (possibly since removal). The optic disc is cupped.

(Recorded and figured in R.L.O.H. Reports, vol. xiii, p. 57).

No. 12.—The outer half of the right eye of a man, aged 25, which was struck by the springing back of a piece of iron he was hitting, four months previous to excision. Since the injury, the eye had been painful, and he had been unable to tell light from darkness with it. At the time of removal the tension was −3. The specimen shows the eye to be considerably flattened from before backwards; the vitreous is shrunken into a small, fibrous mass behind the lens. The retina is detached from the optic disc to the ora serrata, and pushed forwards. There is some enlargement of the suprachoroidal lymph-space anteriorly. The anterior chamber is of good depth. The lens is *in situ*.

No. 13.—The inner half of the eye of a boy, aged 16, which was struck with a stick he was throwing over his shoulder, a fortnight previous to excision. The tension at the time of removal was minus. At the angle of the anterior chamber, on each side, a split is seen, prolonging it outwards. Microscopically it is seen to pass across the fibres of the ligamentum pectinatum which pass to the root of the iris, and to divide the circular from the longitudinal fibres of the ciliary muscle. The lens, iris, and inner portion of the ciliary body are displaced backwards, thus increasing the depth of the anterior chamber. The lens is shrunken at the upper part, and opaque; its capsule

is ruptured. There are blood clots in the vitreous. The retina is detached for a short distance above.

(Recorded in Trans. Ophth. Soc., vol. xii, p. 184.)

No. 14.—The lateral half of the left eye of a woman, aged 60, who, three weeks previous to its excision, was chopping wood, when a piece flew up and struck it. She said it instantly became blind, and had continued very painful. The lens, which is dark in colour, and has a metallic lustre, is displaced into the vitreous. When the eye was first opened it was found to be lying in the lower part, its margin just touching the termination of the ciliary body. In mounting the specimen it has become displaced. The pupil is dilated, and the anterior chamber shallow; its angle is narrowed by the apposition of the root of the iris to the posterior surface of the cornea. The optic disc is cupped. The retina and choroid are *in situ*.

No. 15.—The lateral half of a right eye, in which the sight failed suddenly twenty-eight years previous to removal. It was not ascertained whether or not this failure was preceded by a blow. A fortnight before removal it was scratched by a twig. There is extensive, deep ulceration of the cornea, and a ring of purulent infiltration around it. The anterior chamber has its angle narrowed by the apposition of the root of the iris to the posterior surface of the cornea. It has a mass of lymph in it at its lower part. The lens is displaced into the vitreous chamber; it lies on the lower part of the ciliary body. Its outer layers are of a whitish colour, the nucleus being dark. The vitreous is detached from the retina posteriorly. The optic disc is cupped.

No. 16.—The outer half of the right eye of a woman, aged 56, which, six years previous to its removal, had become suddenly blind, without any inflammation or pain. Four months before its excision she received a blow on it from an open hand. The appearances of the eye, clinically, closely simulated those of a lens dislocated into the anterior chamber. The central part of the cornea is discoloured, being of a rusty-brown hue. This discoloured part ends by an abrupt edge, a little short of the sclero-corneal margin on each side. The lens, which was cal-

careous, has fallen out of the specimen. The anterior chamber is filled with large blood clots. The vitreous is shrunken; the retina detached from the ora serrata to the optic disc. On its outer surface is a cystic protrusion. Microscopical examination shows the discoloration of the cornea to be due to a number of small refracting granules scattered throughout its substance.

(Recorded in Trans. Ophth. Soc., vol. xi, p. 43.)

No. 17.—The inner half of the right eye of a man, aged 40. When ten years old, he struck it against a stone slab. It soon went quite blind, and he was told at the hospital that he had "detachment of the retina." He had never had any pain in it until three weeks before its removal, when an attack came on suddenly one morning. The tension at the time of excision was +1. The angle of the anterior chamber is not now closed; possibly it has opened up in the preparation of the specimen. The lens is *in situ*. The vitreous is shrunken, and has blood clots in it. The retina is completely detached, from the ora serrata to the optic disc. Protruding from its lower and anterior part is a large cyst.

No. 18.—The two lateral halves of an eye (mounted in one cell) of a man, aged 28. When 15, he received a blow on it from a piece of wood 2 ins. square, after which it became blind. For a month previous to its removal he had had attacks of pain and redness in it, and some irritation of his other eye. The periphery of the iris is adherent to the posterior surface of the cornea. The lens is opaque, small, and displaced downwards. The retina is detached from the ora serrata to the optic disc; numerous cysts project from its outer surface. The vitreous is shrunken.

No. 19.—The lateral half of the right eye of a boy, who had been watching a display of fireworks, when something descending struck it. On excision, thirteen days later, the lower half of the anterior chamber was full of blood clots, and none of the iris could be seen. In the specimen the upper part of the iris is seen shrunken, and retracted beyond the sclero-corneal margin. Microscopically this is found to have been rendered possible by the rupture of the ligamentum pectinatum. This rupture, which had occurred throughout the whole circum-

ference of the globe, has also allowed of the separation of the ciliary body from the sclerotic at the lower part; the space left between these structures, and the lower part of the anterior chamber, are filled with blood clots. The lens is opaque, and displaced downwards and backwards: microscopically the capsule is found to be ruptured equatorially. The vitreous, which is streaked with hæmorrhage, is displaced forwards between the upper margin of the lens and the ciliary body. The retina is partially detached.

(Recorded in Trans. Ophth. Soc., vol. xii, p. 185.)

No. 20.—The inner half of the eye of a girl, aged 14 months, who was struck on it by a stone three weeks previous to its removal. The whole of the cornea to within 1·5 mm. of its margin is of a rusty-brown colour, both when viewed externally and on section. In the sclerotic, 3 mm. distant from the middle of the lower corneal margin, was the scar of a small perforating wound; this is not shown in the specimen. The anterior chamber is considerably increased in depth, and filled with blood clot, the iris and lens being much displaced backwards. The vitreous is detached posteriorly, and, for a short distance, antero-laterally. Its anterior part is stained a fawn colour. The retina is *in situ*.

No. 21.—The inner half of the eye of a man, aged 54, which was struck by a piece of shell twenty years ago. It had been quite blind for three years, and had received a second injury seven weeks before excision, from a jet of water of 3,000 lbs. pressure; since then it had been very painful. The anterior chamber is very deep. The lens is displaced downwards; it has a calcareous cortex, and a semifluid nucleus. The retina is detached, from the optic disc to the ora serrata, and is much shrunken. The pigment-epithelium and the choroid are much atrophied; on the inner surface of the latter is some bone, one piece situated around the optic disc, and another at the junction of the ciliary body and choroid.

No. 22.—A piece from the centre of the front half of the eye of a girl, aged 6, who came to the hospital three hours after the receipt of a blow on it from a stone. There was then a wound of the cornea, and a prolapse of iris. The lens was

clear. The prolapsed iris was snipped off. Five days later the eye was excised. There is an extensive rupture of the posterior capsule of the lens, through which the lens substance is protruding. A partially healed wound at the sclero-corneal margin is shown; the iris in this neighbourhood is absent.

(Recorded in Trans. Ophth. Soc., vol. xi, p. 126.)

No. 23.—The inner half of the left eye of a girl, aged 7. Six weeks previous to its excision it was struck by a stick. About the middle of the inner margin of the cornea is a depressed cicatrix. The iris at its upper margin has been detached from the ciliary body; the gap thus left is now filled up with fibrous tissue. The vitreous is shrunken, and has some blood clots in it. The retina is rucked. There are some blood clots between the choroid and sclerotic.

No. 24.—The outer half of an eye of a man, aged 48, who, four and a half years before excision, injured it by a blow against the wing of a carriage. Since that time the sight had been defective. At the time of excision the tension was +2; there was a large hæmorrhage in the anterior chamber, and none of the iris could be seen. The eye is elongated antero-posteriorly. The iris is much shrunken, so that the pupil is extremely dilated. There is adhesion of the periphery of the iris to the posterior surface of the cornea. The uveal pigment turns round its tip, and covers the small portion of its anterior surface that is still free. The lens is in its normal position, but has been cut irregularly in opening the eye. The vitreous is shrunken; the retina detached from the optic disc to the ora serrata. There are blood clots in the anterior chamber, in the vitreous, and between the retina and choroid. The latter is atrophied, the venæ vorticosæ being plainly visible.

No. 25.—The inner half of an eye of a boy, aged 7. Six or seven months before excision he was hammering a piece of glass, and a bit entered the eye, which he said he pulled out himself. His mother stated that the hammer struck the eye. At the date of excision the tension was −2; there was no perception of light. There was a depressed scar in the sclerotic, about the insertion of the internal rectus muscle, and the pupil so

extremely dilated that hardly any iris could be seen. The root of the iris is adherent to the cornea, and the uveal pigment turns round its tip, covering all that portion of the anterior surface that is left free. The lens is misshapen, and displaced upwards, inwards, and backwards towards the depressed cicatrix, to which it is probably adherent. The fibres of the suspensory ligament below and at the outer side are torn through. There is blood clot in the anterior chamber. The retina is detached above from the optic disc up to the ora serrata, and below it is torn away also from the ora serrata. It is much folded, and ballooned out in places.

No. 26.—The lateral half of the right eye of a man, aged 48. When he was nine years old he had a blow on it from a cane; since then he had had no sight in it. He had noticed a white speck on the eye for twelve years. For the last two months it had been inflamed and painful. The tension at time of excision was normal. The lens, which is calcareous at its anterior part, is displaced into the anterior chamber, its lower edge resting against the cornea. The angle of the anterior chamber is large and patent. The vitreous is shrunken. There is extensive pigmentation of the retina, chiefly in the equatorial region. There is no cupping of the optic disc.

No. 27.—The lower half of the left eye of a man, aged 37, who had always been short sighted. Twelve years before excision he received a blow on it from a fist, and the sight gradually failed; one and a half years later he received another blow on it from a snowball. It had been quite blind eight years, but remained quiet until two weeks before excision, when it became suddenly painful. The lens is shrunken, white, and calcareous; it lies quite loose, there being no sign of a suspensory ligament. The retina is contracted and detached in an umbrella form. The pigment epithelium is everywhere very imperfect, and in many parts absent altogether. The choroid is much atrophied.

No. 28.—The two halves of an eye, divided very unevenly in the equator and mounted in separate cells, of a man, aged 31. It was injured by a blow, but there are no further particulars respecting it. The anterior half shows the lens shrunken,

chalky, and white, lying entirely in the anterior chamber. The pupil is oval in shape and has an irregular border. In the posterior half the retina is seen to be everywhere in contact with the choroid, and to have numerous branching patches and dots of pigmentation in it. The pigment epithelial layer is much atrophied, so that the arrangement of the choroidal vessels is plainly visible. The optic disc appears white and excavated.

No. 29.—The upper half of the right eye of a man, aged 56; one month previous to excision, he was chopping wood, when a piece flew up and struck it. The sight failed gradually and at the time of excision he had no perception of light. The lens, which is now very white and opaque (the result of the hardening solution), is displaced outwards, so that its outer border is in contact with the ciliary processes and root of iris on that side. On the inner side there is a large space left between the margin of the lens and the ciliary body, through which the vitreous comes forward into

FIG. 1.—Specimen 29, showing lateral displacement of the lens and the vitreous passing forwards round its margin iuto the anterior chamber. × 2½.

the anterior chamber (Fig. 1), it being completely detached posteriorly. The root of the iris in its entire circumference is in contact with the periphery of the cornea, blocking the angle of the anterior chamber. The retina is in position and the optic disc deeply cupped.

No. 30.—The lateral half of the left eye of a man, aged 59. It had been injured fifty years previous to excision by a whip, after which the sight failed; lately it had become irritable. There was a broad, transverse calcareous film of the cornea, which has become rubbed off the specimen in mounting, leaving clear cornea behind. The lens is shrunken, and has a dense band of calcareous opacity in it. The vitreous is much shrunken and detached posteriorly. There is extensive pigmentation of the retina, in the form of dots and irregular branching patches, chiefly at the equator; it is *in situ*. The choroid is much atrophied.

No. 31.—The outer half of the left eye of a boy, aged 10. Four days previous to excision it was struck by the stick of a catapult with which he was shooting. The tension became minus. The anterior chamber is deep; the iris is torn away from its attachment to the ciliary body below, some blood clots intervening between them. Above, the angle of the anterior chamber is prolonged outwards, those fibres of the ligamentum pectinatum which go to the root of the iris being ruptured, and the ciliary

FIG. 2.—Specimen 31, showing the prolongation outwards of the angle of the anterior chamber on one side, and the detachment of the iris from the ciliary body on the other. × 2½.

muscle split (Fig. 2). The lens is cataractous, and its lower part is broader than its upper. Microscopically an extensive rupture is seen in the capsule at its equator below. The lower part of

the suspensory ligament has also been torn across, the vitreous coming forwards between the lens and the ciliary processes. The vitreous is detached in places from the retina and has blood clots in its lower part. There are rucks in the retina.

Subseries (B).—*Ruptured Eyeballs.*

When an eyeball bursts as the result of a blow upon it from a blunt object, the rupture is nearly always found to have occurred in the same part of the eye, that is, in the sclerotic about 2 or 3 mm. distant from and concentric with the corneal margin (Nos. 16, 17), the probable reason being that this is the thinnest portion of the sclerotic, unsupported by the tendons of the recti muscles or by orbital tissues, and that it is here thinner than the cornea. On the inner surface of the eye, the rupture usually passes just in front of the ciliary muscle into the extreme periphery of the anterior chamber (Nos. 1, 2, 5, 12, 13. See Fig. 3), so that, if the suspensory ligament remained intact, the vitreous chamber would not be opened up. The portion of the circumference of the sclerotic in which ruptures are most frequently met with is the upper, or upper and inner part. They occur on the opposite side to that on which the blow is received, and the eye is protected from injuries above by the brow and on the inner side by the nose. Ruptures occurring in other situations than the above indicated are accounted for either by the condition of the eye previous to the injury, which caused its walls to be abnormally weak in one position (Nos. 4, 10, and 19), or to some irregularity in the shape of the foreign body with which it came in contact (Nos. 6, 7, and 15).

Various portions of the contents of the globe may escape, either partially or entirely, through the wound. If the conjunctiva is not involved in the lesion (Nos. 4, 12, 18, and 20), they will be found lying beneath it.

It is very common to find the iris in the neighbour-

hood of the rupture folded and prolapsing into it (Nos. 2, 8, 12, 13, and 14. See Fig. 3). Sometimes the iris becomes completely detached, having been torn through at its thinnest part, *i.e.*, where it joins the ciliary body, then either escaping completely from the eye (No. 20), or lying partially in the wound and partially in the anterior chamber (No. 1). The suspensory ligament rarely escapes being torn, the lens consequently being either displaced forwards towards the wound (Fig. 3. Nos. 12 and 13), or still more frequently escaping through it in its capsule away from the eye (Nos. 2, 3, 4, 5, 8, 9, 11, and 14); occasionally the capsule bursts, and remains *in situ* while its contents are extruded (Nos. 1 and 15). The suspensory ligament being torn, the vitreous comes forwards, prolapsing, or escaping to a greater or less extent (Nos. 9, 10, 14, 16, and 19). Following on the displacement of the vitreous comes detachment of the retina (Nos. 1, 2, 6, 7, 8, and 9), which may also prolapse from the wound (No. 14).

In this class of case hæmorrhage from the choroidal vessels between the choroid and sclerotic frequently occurs (Nos. 3, 4, 10, 17, and 19), detaching the former, together with the retina. Hæmorrhages are also found sub-conjunctivally (Nos. 4 and 12); in the anterior chamber (Nos. 9, 11, and 18); in the vitreous (Nos. 3, 5, 9, 11, 12, 13, 14, and 20); and between the retina and choroid (No. 7).

In recent ruptures of the eye the lips of the wound are found everted (Nos. 9, 10, and 19); when, however, cicatrisation has taken place they become inverted (Nos. 2, 5, 6, and 15).

No. 1.—The lower half of an eye which was ruptured close to the sclero-corneal junction by a blow. The rupture is well shown; its edges are thickened. The iris has been completely detached except close to the wound, into which part of it projects. The retina is detached from the optic disc and choroid, and from the ciliary body over the greater part of its extent. The detachment in the part opposite the wound includes the sus-

pensory ligament, which is torn away up to the tips of the ciliary processes. On the side of the globe corresponding to the wound, the retina is detached only as far as the ora serrata. The lens is absent, but its capsule is still present.

No. 2.—The lower half of an eye of a boy, aged 13, ruptured by a blow. It is somewhat irregularly diminished in size. The rupture occurred at or close to the sclero-corneal junction. The wound is now well healed, both its lips being inverted, and the small space between them filled by lymph and partly by iris which has prolapsed. The inversion of the lips of the wound has produced a puckering on the outer surface of the globe. The lens is absent. The part of the iris opposite that which has prolapsed into the wound is stretched and lies almost in contact with the cornea. The retina is detached from the choroid, remaining adherent at the optic disc; it is also torn for a great extent from the ora serrata on the side opposite the rupture: it is grey, opaque, and folded.

No. 3.—The lateral half of an eye ruptured by a blow. The rupture has taken place at or close to the sclero-corneal junction; the edges of the wound are widely separated, and the interval between them partially filled with coagulated blood, and blood-stained membranes. The iris is barely distinguishable, and is pushed against the cornea. The choroid can be seen only on the side corresponding to the rupture; elsewhere it has become detached from the sclerotic, and is hidden by blood clot. The retina cannot be distinguished anywhere with certainty, a blood-stained membrane on the side corresponding to the rupture may be part of it. The vitreous chamber is quite filled with red blood-clot. The lens is absent.

No. 4.—The left eye of a man, aged 30, partially divided into two lateral halves, which are left attached behind. Sixteen years previous to its excision it was wounded by an arrow; the vision became greatly impaired and remained so. During the succeeding years he received many blows on it, and after one especially severe one on the temple two years before excision, the eye began to enlarge. The injury which led to the removal

of the eye was a blow ten days before, which ruptured it. The rupture has occurred at the thinned staphylomatous part of the sclerotic in the lower and outer ciliary region. The sclerotic is thinned throughout, especially in front. There is a subconjunctival swelling over the rupture caused by coagulated blood. The globe is much enlarged and of an irregular oval form. The lens is absent; it probably escaped through the rupture. The choroid and retina are detached and pressed forwards towards the posterior surface of the iris. The whole subchoroidal space, which is very large, is filled with blood clots which have now become a chocolate-brown colour.

No. 5.—The inner half of an eye, divided rather unequally, of a woman, aged 55, which was ruptured by a blow. The rupture has occurred a little behind the junction of the cornea and sclerotic. The lips of the wound are slightly inverted and cicatrisation has taken place. The iris is *in situ*. The lens is absent. There has been hæmorrhage into the vitreous.

No. 6.—The lower half of the eye of a man, aged 46, which two months previous to removal was "gouged" by another man. The sight was immediately lost, and some bleeding occurred. The eye is somewhat shrunken and much misshapen. The puckering, however, at the front and outer side occurred during the preparation, and was not present during life. At the equator on the inner side is a deep groove filled by inflammatory material and marking the seat of probable rupture. The sclerotic is everywhere somewhat thickened; at the seat of rupture it is inverted, and the lips of the wound again everted from one another. The ciliary body and iris are detached from the sclerotic and rolled backwards by a thick spongy mass of partly decolorised blood clot, which occupies the ciliary region and the position of the lens, and extends on the wounded side within the sclerotic as far back as the optic disc. The retina is detached and much folded. The outer part of the subretinal space is occupied by blood. The vitreous chamber contains blood clots, and in its lower part is seen the lens in its capsule with its posterior surface looking upwards.

No. 7.—The outer half of the left eye of a girl, aged 8.

Two and a half months before excision she struck it against a door latch. At the time of excision it was quite blind. T. — 2. There was a scar running vertically through the cornea from about its centre extending upwards into the ciliary region. The eye is much misshapen from puckering of the sclerotic, especially on one side. The wound in the cornea is filled with shreds of retina which protrude from it. The upper part of the wound (that in the ciliary region) is closed by a large and prominent mass of lymph involving the prolapsed iris. The retina is folded together in the upper part of the globe, being totally detached from the choroid and the optic disc. The sub-retinal space was filled with blood, which has been removed. The ciliary body at the seat of wound is much thickened.

No. 8.—The two lateral halves of an eye, preserved in separate cells. Eight years previous to removal it was ruptured by a blow. The eye is much shrunken. The situation of the rupture is shown by a deep pucker leading to a pigmented scar close behind the sclero-corneal margin. The lens is absent, and no doubt escaped at the time of the accident. The iris in the neighbourhood of the rupture has become incarcerated in it. The retina is detached everywhere, except at the optic disc and that part of the ciliary body nearest to the wound. On that part of the ciliary body from which the retina has been torn away and which is furthest from the wound, there is a broad crescent of opaque, white fibrous tissue. On the inner surface of the choroid are several scattered small white clots, probably colloid bodies.

No. 9.—The outer half of the left eye of a woman, aged 49. Eight days previous to removal it received a blow from a fist. A rupture with its margins everted is seen in the sclerotic a short distance from the upper corneal margin. The lens is absent. The upper part of the iris cannot be distinguished; the lower part is displaced backwards by a large blood clot which fills the anterior chamber. The vitreous has partially escaped at the wound; it contains blood clots. The retina is detached for a short distance posteriorly.

No. 10.—The inner half of the left eye of a girl, aged 16. It was blind as the result of ophthalmia neonatorum, the cornea

being leucomatous and slightly prominent. The day before excision it was struck by a blow from a stick. There is a gaping perforation of the cornea a little to one side of its centre. The edges of the wound are everted, swollen, and opaque; the iris has prolapsed into it. The lens is absent; it may have been lost at the time of the accident or as the result of the ophthalmia neonatorum. The vitreous has in great part escaped. There has been extensive hæmorrhage between the choroid and sclerotic.

No. 11.—The outer half of the eye of a man, aged 48, which had been ruptured by a blow from a stick. The rupture, which was just external to the corneal margin, is not shown in the specimen. The lens is absent. There is blood clot in the anterior chamber, also between the ciliary body and sclerotic. In the anterior part of the vitreous is a dark coloured, conical mass of blood clot. The retina and choroid are *in situ*.

No. 12.—The inner half of the left eye of a man, aged 38, which thirteen days previous to excision was injured by a blow from a piece of wood which another man was chopping. There is a large subconjunctival hæmorrhage at the upper part of the globe, and a rupture of the sclerotic just outside the sclero-corneal margin. The iris at the upper part has become folded. The lens is displaced forwards in front of the iris into the anterior chamber. There are blood clots in the vitreous, which is detached posteriorly. The retina is *in situ*.

No. 13.—The inner half of the left eye of a woman, aged 50, who three weeks previous to the date of excision had received a blow on it from a fist. In the sclerotic just outside the sclero-corneal margin at the upper part of the globe is a rupture; the iris at the upper part has prolapsed into it, being doubled on itself. The lens is displaced slightly upwards and forwards, and is just presenting at the rupture. Its suspensory ligament above is probably torn through. There has been some hæmorrhage into the vitreous. The choroid at the lower part is detached for a short distance from the sclerotic.

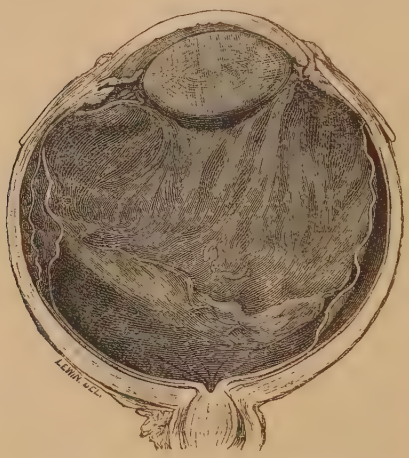

FIG. 3.—Specimen 13, showing the position at which a rupture of the sclerotic occurs, prolapse of the iris into the wound, and displacement of the lens and vitreous. × 2½.

No. 14.—The lateral half of the right eye of a woman. Five days previous to the date of excision, she was stooping down to pick up something from the floor, and in rising struck her eye against the handle of a frying pan. The globe is somewhat collapsed. There is a gaping rupture of the sclerotic just outside the corneal margin and just in front of the commencement of the ciliary body at the upper and inner part. The lens is absent. The iris at the upper part is folded back into the rupture. The vitreous has in great part escaped; there are blood clots in it, and it, together with the detached retina, is prolapsing at the wound. The choroid is detached from sclerotic both above and below.

No. 15.—The inner half of the left eye of a man, aged 39. It had been injured two months previous to removal by a blow against the handle of a winch. There is a puckered cicatrix on the inner side extending from the corneal margin to beyond the insertion of the internal rectus muscle. The anterior chamber is deep. A membrane extends across the globe between the aqueous and vitreous chambers, composed of iris

(stretched and torn), blood clots, lens capsule, and shrunken vitreous.

No. 16.—The whole eye of a woman, aged 43, which was injured by a blow a week previous to removal. In the sclerotic, 2 mm. distant from the upper margin of the cornea and running concentric with it for a distance of 12 mm., is a recent gaping rupture. The vitreous was protruding from it, but has been cut away so as to show better its position with reference to the corneal margin and the insertion of the superior rectus tendon. The anterior chamber is full of blood.

No. 17.—The two halves of the left eye, divided by an equatorial section, of a man, aged 58. Three days previous to excision, he received a blow on it from a fist. In the sclerotic, concentric with the corneal margin at the upper part and 2·5 mm. distant from it, is a recent rupture measuring 14 mm. in length. There are large recent blood clots between the choroid and sclerotic.

No. 18.—The outer half of the left eye of a woman, aged 69. Fourteen days previous to its removal she fell, striking it against a balustrade. There is a rupture in the sclerotic a little external to the upper corneal margin. The lens is seen lying over the rupture subconjunctivally. The anterior chamber is full of blood clots. The relations of the iris at the seat of the wound cannot be definitely made out; it seems to have been torn through. There are extensive blood clots in the anterior portion of the vitreous. The retina is *in situ*.

No. 19.—The lateral half of the somewhat collapsed eye of a woman, aged 35. Eleven years before there had been a cataract extracted from it, and five days previous to its removal it received a blow from a hand. There is a large gaping wound at the upper part of the cornea, evidently the extraction cicatrix reopened up. The corneal flap is bent back. The vitreous has in great part escaped; there are blood clots in the wound, and also extensive blood clots between the choroid and sclerotic.

No. 20.—The lateral half of the left eye of a woman, aged 70. About two months previous to its excision she had struck it

against the foot of a chair. In the upper part of the sclerotic, 5 mm. behind the corneal margin, is a rupture which measured 18 mm. in length. The conjunctiva over it is intact. Between it and the sclerotic is seen a dark yellowish, oval mass surrounded by a white ring. This, microscopically, is found to be the lens, with round celled infiltration encircling it. A small mass of pigmented tissue behind the lens, also beneath the conjunctiva, is the iris completely torn away from its attachment to the ciliary body. There are blood clots in the anterior portion of the vitreous. The retina is *in situ*.

(Recorded and figured in R.L.O.H. Reports, vol. xii, p. 347.)

Subseries (C).—*Eyes Wounded, but not containing a Foreign Body.*

Wounds of the eye are either perforating or non-perforating. Non-perforating wounds of the cornea heal readily, and leave but slight scars or *nebulæ*, unless some phlogogenetic substance be inoculated, when infiltration and ulceration follow (No. 27). In such cases a collection of pus frequently forms in the lower part of the anterior chamber (*hypopyon*): this exudation comes from the vessels of the iris and ciliary body, and is excited by a diffusion of the inoculated poison to them.

Perforating wounds of the cornea are necessarily followed by the escape of some of the contents of the eye, which may be the aqueous humour; part (Nos. 1, 2, 21, 22, and 39), or the whole of the iris (No. 26. See Fig. 4); part or the whole of the lens (Nos. 2, 8, 16, 20, 26, 33, and 35); or the vitreous.

Sometimes after a perforating wound of the cornea, in which the aqueous has alone escaped, perfect coaptation of the edges may not take place; leakage will then go on through it, and the anterior chamber does not reform. The plastic effusion subsequently thrown out around the wound to close it, glues structures in contact with its posterior surface to it, and in this way an anterior adhesion or *synechia* of the iris (No. 24) or lens capsule (No. 38)

becomes formed. Anterior synechiæ of the iris, however, more frequently result from a portion of it being carried into the wound with the gush of the escaping aqueous at the time of the injury (Nos. 1 and 39), and anterior synechiæ of the lens capsule occur mostly when it has been wounded and some of its contents has escaped (Nos. 16, 17, 20, 33, 34, 40, and 43). If the whole lens has escaped, the vitreous may be displaced forwards, and an anterior synechia of it thus formed.

After wounds of the lens, the solvent action of the aqueous humour on its substance comes into play; it becomes opaque, and considerable portions of it become absorbed. It is difficult, in eyes removed some time after the injury, to say how much of the lens has become thus absorbed, and how much escaped at the time of the injury. Portions of a wounded lens left in the capsule, which have not been absorbed, frequently become the seats of calcareous deposit (Nos. 5 and 11).

The structures implicated in a perforating wound of the sclerotic vary with the distance it is situated from the sclero-corneal margin. In the more anterior wounds the iris and lens may become involved (Nos. 18 and 22), in those further back the retina (Nos. 31 and 36); through all some escape of vitreous usually occurs. Occasionally the retina may become extensively detached and prolapse through wound (No. 22).

The approximation of the edges of a sclerotic wound is not usually so accurate as in one of the cornea, its margins being usually found inverted (Nos. 3 and 36). More cicatricial tissue and more puckering is formed in the process of healing. The retina is often much folded and rucked in its neighbourhood (Nos. 31 and 36).

Occasionally the body which injures the eye causes besides the opening by which it enters, a wound of (No. 32), or a counter-opening in (No. 29), its tunics on the opposite side.

The hæmorrhages found in eyes after perforating

wounds are not usually so extensive as in those which have been ruptured. They may be met with in the following parts, varying with the extent and position of the wound:—in the anterior chamber (Nos. 3 and 21); in the vitreous (No. 20); between the retina and choroid (No. 37); between the choroid and sclerotic (No. 21); and in the substance of the retina or choroid.

Suppurative exudation into the vitreous after perforating wounds of the eye is very common; it is the result of the introduction of septic material. It may follow on even such a small wound as that produced by the prick of a thorn (No. 30). The suppuration is sometimes very localised (No. 34), at others diffused throughout it (Nos. 1, 8, 19, 30, 37, and 39); occasionally it spreads in the form of a ring (No. 41). Suppurative panophthalmitis ends by the necrosed margins of the wound giving way, and the whole contents of the globe becoming extruded. In such cases considerable adhesions are formed between the orbital tissues and the sclerotic (No. 44).

An inflammation less acute, and in which the exudation is of a more plastic character, is also met with after perforating wounds; the uveal tract is the part primarily affected, though others may become involved. It frequently relapses, often after long intervals, and may spread to the other eye, giving rise to what is termed *sympathetic ophthalmitis* (Nos. 4 and 5).

Various changes may be met with in wounded eyes which are either the result of organisation and contraction of inflammatory products, or degenerations in structures whose function has been destroyed.

The vitreous frequently shrinks, and its hyaloid becomes detached from the retina; if it retains its adhesion to the optic disc, it assumes a pyramidal shape (Nos. 19, 24, and 27); if this also gives way its posterior border becomes irregularly cresentic (Nos. 33, 34, 38, and 40). Serous fluid fills the space left between the detached hyaloid and retina. Detachments of the anterior part of the vitreous are much

less common. A separation occurring between the anterior hyaloid and the posterior fibres of the suspensory ligament, from the ora serrata to the side of the lens capsule, is spoken of as an antero-lateral detachment (Fig. 5. Nos. 27 and 33). It is also said that a separation may occur between the anterior hyaloid and the posterior capsule of the lens; there is no specimen showing this in the collection. Should adhesion take place between the hyaloid membrane and the retina previous to its shrinking, then in its contraction it will drag the retina away from the choroid (Nos. 10, 24, 28, 30, 35, and 37). Frequently dense bands of fibrous tissue form in the vitreous, and in eyes removed some considerable time after the injury such a band is often found stretching across the globe behind the lens, forming a *cyclitic membrane;* this, by its contraction, separates the ciliary body and anterior portion of the choroid from the sclerotic (Nos. 3, 11 and 17).

A band of cicatricial tissue forming in the track of a wound will cause displacement of the iris and lens if adherent to them (No. 36). One forming in the track of a shot, which has passed right through the globe from before backwards, will, in contraction, flatten it antero-posteriorly (No. 29).

Detachment of the retina from the uveal pigment layer does not involve the tearing through of any tissues; it is simply the opening out of a potential cavity, viz., that of the primary optic vesicle. It may be partial (Nos. 5, 16 and 24) or complete. When complete, the retina still retains its normal attachments at the optic disc and ora serrata (Nos. 3, 4, 10, 14 and 17); these, however, in rare cases, may become severed. A completely detached retina assumes the shape of an umbrella, and in course of time becomes much atrophied, the portion corresponding to the stick of the umbrella becoming exceedingly thin (No. 25); sometimes cysts form in it, and project from its outer surface (Nos. 18 and 28). When, as the result of inflammation, firm adhesion takes place between the retina, its

uveal pigment layer and the choroid, then detachment becomes impossible. In such cases the uveal pigment proliferates and grows into the retina, chiefly along the course of its blood-vessels, causing branching patches of pigmentation in it (No. 9). If the adhesions are weak, or only of recent formation, they are unable to withstand the force exerted by the traction of a shrinking and fibrous vitreous, the retina then becoming detached with portions of uveal pigment adherent to it (No. 28). Sometimes at one point the retina will remain adherent to the choroid when all the rest has become detached; a band of retinal tissue will then stand out from the main mass, as a sort of pillar (Nos. 10, 35).

Wounded eyes, in which there has been a plastic choroiditis, sometimes develop plates of bone on the inner surface of the elastic lamina. It is most frequently met with around the optic nerve, a hole being left in the centre of the plate, through which the fibres of the optic nerve pass (No. 6). Bone is also sometimes deposited anteriorly, at about the junction of the ciliary body and choroid.

In eyes removed some years after the injury, the portion of bone developed anteriorly may have become united to that around the optic nerve, the two together forming a complete cup (No. 7).

The angle of the anterior chamber may become blocked, as the result of an adhesion of the iris or lens capsule to a wound in the cornea; the exit of fluids from the eye is then arrested, and the tension increased. If this is left unrelieved, the whole globe may become enlarged, and a staphylomatous condition of the cornea or ciliary region formed (Nos. 15, 26 and 42).

No. 1.—The lateral half of an eye which had received a penetrating wound at the sclero-corneal margin. The wound is closed on its outer surface by a prominent mass of lymph, which extends for a considerable distance around its margins, covering parts of the cornea and sclerotic. The cornea is thick-

ened close to it, but in other parts appears normal. The part of the iris near the wound has prolapsed into it, and lies embedded in the mass of lymph outside it. The rest of the iris is thickened and stretched. The pupil, which is filled by opaque greyish-yellow lymph, is drawn upwards. The lens has been removed from the specimen. The vitreous chamber is occupied at its periphery by opaque yellowish-grey pus, especially abundant in the hyaloid fossa. The retina and choroid are both thickened.

No. 2.—The lateral half of the much shrunken eye of a boy, aged 10. Two months previous to excision it was wounded by an arrow. Antero-posteriorly it is much flattened. There is the scar of a firmly healed wound at the sclero-corneal junction, the margins of which are inverted. The lens is absent, the sclerotic thickened. The ciliary body and choroid on the side opposite to the wound are separated from the choroid by the contraction of cicatricial tissue in the vitreous. The iris in the neighbourhood of the wound is absent. The retina, detached and shrunken, forms a solid cone in the centre of the globe.

No. 3.—The lateral half of a shrunken eyeball, from a girl, aged 10. She had punctured it with scissors three months before excision. It is much misshapen. A very marked indentation of the sclerotic at the equator on one side probably marks the seat of the wound. The anterior chamber is distended by a large red blood-clot which has displaced backwards the iris. The lens is absent. The vitreous is shrunken; by its contraction it has drawn inwards the ciliary body on the side opposite the wound. The retina, shrunken and detached up to the ora serrata (except at the optic disc), forms a solid conical mass. The subretinal space was filled by flocculent greyish-yellow material, in parts blood-stained, which has been removed.

(Recorded in R.L.O.H. Reports, vol. vii, part 2.)

No. 4.—Part of the left eye of a man, aged 34, who came under observation on account of inflammatory sympathetic mischief in his right eye. Three years before, his left had been wounded. The injury was followed by immediate loss of sight and by an inflammatory attack of six weeks' duration,

after which it remained quiet. The right eye did not begin to suffer until after the injured eye had become "quiet." The globe is much shrunken; a wrinkled scar passes right across the cornea. The sclerotic is throughout much thickened. The iris is adherent to the corneal scar. The supra-choroidal lymph space is enlarged anteriorly; there are colloid nodules amongst the pigment-epithelium on the inner surface of the elastic lamina. The retina is detached in umbrella form as far as the ora serrata; it is shrunken and wrinkled. The vitreous space has not been opened up.

No. 5.—The inner lateral half of the much shrunken eye of a boy, aged 16. When five years old he wounded it with a piece of glass and the sight was destroyed; since that time he had had no trouble or pain in it. Twelve months previous to excision gradual failure of the other eye had commenced, accompanied by pain and redness. The cornea has a transverse scar passing across its inner part. There is no anterior chamber, the iris being in contact with the cornea and probably adherent to the cicatrix. The lens is opaque, shrunken, and of stony hardness. The vitreous and retina are shrunken, the latter slightly detached in folds from the choroid. The ciliary body and choroid are thickened.

No. 6.—Plate of bone, preserved dry, removed from the inner surface of the choroid of the eye of a man, aged 33. Six years previous to excision he had wounded the eye with a fork. The outer surface of the bone is evenly curved, corresponding to the spherical curve of the ocular tunics; its inner surface is very irregular. The entrance of the optic nerve is seen as a round hole in the middle of the thinnest part of the bone, and this thinnest part forms a small translucent plate, which passes abruptly into a much thicker mass of bone towards the equatorial region. The thickest part thins off somewhat gradually, and ends at about the equator, except on one side, where it is prolonged to the ciliary region. The specimen, therefore, forms a cup whose outer surface is regular, but its cavity much diminished by irregular thickening of its wall.

No. 7.—A bony cup, preserved dry, removed from the inner surface of the choroid of the eye of a man, aged 52. When he

was 23 years old it had been wounded by a piece of iron, and since then had been quite blind. His other eye had not suffered sympathetically. Both the inner and outer surfaces of the bony cup are irregular. At its posterior part there is a small aperture for the entrance of the optic nerve. The bone around this aperture, which is the thinnest part of the cup, is tolerably smooth. The ring of bone developed at the posterior part of the ciliary region is incomplete; on one side this ring is blended with the rest of the cup; on the other, it is separate from it The globe from which it was taken was considerably shrunken, and the bone moulded on its inner surface.

No. 8.—The eye of a patient, aged 18. It has been divided antero-posteriorly, and each half again bisected. The front and back parts of the eye are preserved in separate cells. Four weeks previous to excision it was wounded by a piece of brass which was thrown at it. The other eye had become weak and photophobic, but recovered soon after the excision. The globe is considerably shrunken, the front part puckered. There is no lens present. The iris appears much shrunken and is adherent to the cornea. The retina at the anterior part is drawn forwards and much puckered, occupying the position of the lens; posteriorly, about the entrance of the optic nerve, it is thickened. The vitreous chamber was quite full of yellow pus; this has been in great part removed, but is left in one posterior quarter of the globe. There is a good deal of opaque flocculent matter between the retina and choroid.

No. 9.—The outer half of the left eye of a woman, aged 42. It was wounded by scissors when she was a year old. It was occasionally painful for about six years, but then became quiet, and remained so till six weeks before excision, when after a cold it became painful and inflamed. The globe is shrunken; at the upper part of the cornea was a scar, a portion of which shows in the specimen. The iris is thinned, and everywhere in contact with the cornea; at the upper part, near the scar, it is firmly adherent to it. The lens, which has been removed, consisted of an opaque, yellow, roundish nodule. The retina is *in situ*. In the equatorial region it is very deeply pigmented. The pigment is arranged in the form of variously sized

roundish masses, intermixed with many lines and branching figures.

No. 10.—The lateral half of a right eye, which was injured two years before excision by a percussion cap. The iris is shrunken; it shows at one part of its pupillary border a notch occupied by lymph, and probably the seat of the wound. The lens is absent, but one layer of its capsule is well seen. The retina is detached from the optic disc as far forwards as the ora serrata, except at one spot where a round pillar extends backwards from its outer surface to the choroid, to which it is firmly attached. The choroid in this position is slightly drawn inwards away from the sclerotic.

The retina, together with shrunken and fibrous vitreous to which it is adherent, forms a solid, irregular, triangular mass at the back of the lens-capsule and ciliary body.

No foreign body was found, but it may be still embedded in this mass out of sight.

No. 11.—The anterior half of a much puckered eye from which one half of the cornea has been removed. It was excised from a man, aged 47, who received a prick in it from a thorn four years previously. The lens in its capsule, partly calcified, lies loose in the cell. Stretching across the ciliary region behind the position occupied by the lens is a thick, white, firm diaphragm, probably composed of shrunken and now fibrous vitreous, and of detached retina.

No. 12.—The lateral half of the eye of a man aged 23, who, five years previous to its excision, had received a stab in it from a knife. Vision was lost at the time or soon after; recently it had become several times spontaneously inflamed.

The eyeball is somewhat shrunken; its shape, however, is good. The cornea and iris look normal. The lens is absent. The retina is detached, and in great part shrunken into an opaque cord; part of it retains much of its membranous and transparent characters. On this side there is a slight detachment of the choroid and ciliary body, in the region of the ora serrata. On the outer surface of the thick opaque part is a large, brownish patch, probably of old blood.

No. 13.—The lateral half of the right eye of a woman, aged 41, who, thirteen years previous to excision, received a scratch on it; this was followed by inflammation, which persisted for twelve months. The cornea shows a large scar, where its tissue is thickened, and to which a considerable part of the iris is adherent. The lens is absent; in the situation of its capsule is a thick layer of tough, white fibrous tissue which occupies the entire hyaloid fossa. The retina and choroid appear healthy.

No. 14.—The two halves of the much misshapen shrunken eye of a patient, aged 35. Twenty-five years previous to its removal it had been injured by a piece of percussion cap. It had been irritable during the last eighteen years. The much shrunken remains of the cornea has an adhesion of iris to it at one spot. There is no lens. The sclerotic and choroid are both much thickened, the latter forming a thick, brown, somewhat lax-looking layer between the former and the remains of the retina. The retina and vitreous are represented by an opaque, white mass, passing from the optic nerve forwards in the interior of the eye.

No. 15.—The lower half of the left eye of a woman, aged 38, which was wounded with a piece of glass when she was a child. It was inflamed for a long time afterwards, and the vision was lost. Subsequently it began to enlarge, and, during the last three years, had occasionally been very painful. The whole eyeball is increased in size, the chief lengthening has taken place in front of the ora serrata. The sclerotic is considerably thinned, especially in front of the equator. In the yellow spot region there is a well-marked posterior staphyloma of circular outline about 6 mm. in width. The iris is thinned out, and in close contact with the cornea. The lens and its capsule are represented by an opaque, white, thin disc, which is firmly adherent to the centre of the cornea; the much elongated suspensory ligament is seen attached to its margins. The retina, when the eye was opened, was in position; it has now become detached and torn, its pigment epithelium has also become removed in large patches. The choroid in the region of the staphyloma is much thinned, and a thin layer of an atrophied retina is adherent to it.

No. 16.—The lower half of the eye of a butcher, who ran a broad-pointed knife into it four months previous to its removal.

There is a vertical cicatrix in the cornea, to which the lens capsule is adherent by a band of lymph, the greater portion of the lens being absent. The iris is adherent to the lens capsule at its pupillary border, and bowed forwards elsewhere into contact with the cornea. The vitreous is shrunken and detached posteriorly; it is infiltrated, having numerous yellow streaks in it. The retina is detached from the choroid, the space between them and also that between the detached vitreous and retina being filled with a gelatinous substance.

No. 17.—The lower and inner half of the eye of a boy, aged 10, which was wounded seven weeks previous to its removal by a "tip cat." The healed scar of the wound is seen near the upper margin of the cornea, which is swollen in its neighbourhood. To the inner end of the scar the lens capsule is adherent, the iris being absent at this part (removed by operation after the accident). The lens is thus displaced upwards and inwards, and its upper edge tilted forwards. The nuclear portion of the lens is more opaque than, and sharply defined from, the cortex. There is an umbrella-shaped detachment of the retina. The shrunken vitreous contains some blood clots; by its contraction it has drawn inwards the ciliary body and anterior part of the choroid, slightly separating them from the sclerotic.

No. 18.—The lateral half of the left eye of a man, aged 55. The eye had been blind for fifteen years previous to removal, from the effects of a wound by a stone. In the ciliary part of the sclerotic below, there is a scar, to the inner surface of which the vitreous and retina are firmly adherent. The iris is adherent to the periphery of the cornea, and at its pupillary edge to the lens capsule; in the interval it is bulged forwards. The lens is partially opaque and misshapen, being narrower below than above. There is some old, partly decolorised blood-clot close to its lower border. The retina is extensively detached, and from its outer surface project three cysts. Their walls are thin and semi-transparent, but the base wall, which is in the line of the retina, is considerably thicker: their contents were soft, opaque, and jelly-like. The subretinal space was filled by a thin fluid.

(Recorded and figured in R.L.O.H. Reports, vol. xi, p. 210.)

No. 19.—The lateral half of the eye of a boy, aged 8, which was injured three weeks before removal by a fork. There is the scar of a small punctured wound at the lower sclero-corneal margin. The pupil is drawn downwards, and there are adhesions between the iris and lens capsule. The lens does not appear to have been wounded. The vitreous is shrunken and detached from the retina, remaining adherent in the ciliary region and at the optic disc; there has been purulent exudation into it, this being most marked at the lower and anterior part. The retina and choroid are in position. The optic disc is swollen.

No. 20.—The lower half of the left eye of a girl, aged 9, which was wounded by a steel pen one month before excision. There is a vertical, puckered cicatrix in the centre of the cornea, from which a band of cicatricial tissue passes backwards to the lens capsule. The lens is in greater part absent, some of its peripheral portions remaining. The iris is unaltered. The whole vitreous is filled with dark blood clots. The retina is *in situ*, and the optic disc greatly swollen.

No. 21.—The upper half of the right eye of a boy, aged 8, which was wounded by a penknife three days previous to its removal. An unhealed wound is seen in the inner half of the cornea, into which a portion of the iris has prolapsed. A large portion of the lens has escaped; some of the outer part is left. There are blood clots in the anterior chamber, in the vitreous, and between the sclerotic and the choroid and ciliary body.

No. 22.—The lateral half of the left eye of a boy, aged 8. Eleven days previous to its removal it was wounded by a stone. There is a large, gaping wound in the sclerotic, close to the corneal margin. The anterior chamber is very deep, the iris and lens being displaced backwards; in the recent state it was full of blood clots. The retina is extensively detached, remaining adherent only at the optic disc; from here it passes forwards in numerous folds, and, together with the iris, prolapses into the wound. The ciliary body and anterior part of the choroid are separated from the sclerotic.

No. 23.—The lateral half of the eye of a child, aged 4.

Three months previous to its removal it was wounded by a knife. There is a well-healed cicatrix in the lower part of the cornea, to which the iris is adherent. The lens is shrunken and opaque. The retina is attached to the posterior surface of the lens, being drawn forwards, partially detached, and puckered.

No. 24.—The lateral half of the left eye of a girl, aged 9. A month previous to excision, a little boy poked his finger nail into it. A horizontal cicatrix in the cornea is shown, to which there is an adhesion of the iris. The lens is *in situ* and appears healthy. The vitreous is shrunken and detached from the retina; it is still adherent at the optic disc. It has some thickened, greyish bands in it. In the lower part of the specimen the hyaloid of the vitreous has acquired an adhesion to the retina, and the contraction of bands in the vitreous is drawing the retina away from the choroid. There is a large ruck in the retina on one side, and several small puckers around the optic disc.

No. 25.—The lateral half of the eye of a woman, aged 38. It had been wounded by a piece of glass in childhood. Six weeks before excision it became inflamed. There is a vertical scar in the lower part of the cornea, to which the iris is adherent. The anterior chamber is very shallow. The lens is opaque. The vitreous is shrunken, with yellow infiltration and hæmorrhage into it. There is an umbrella-shaped detachment of the retina, the portion corresponding to the stick of the umbrella being exceedingly thin; it has broken across in mounting the specimen. The ciliary body and anterior portion of the choroid are detached from the sclerotic by the contraction of the shrunken and fibrous vitreous.

No. 26.—The lateral half of the right eye of a man, aged 26, who twelve years previous to excision wounded it with a chisel. Sight was completely destroyed, and during the last few years the eye had gradually enlarged. The tension at the time of excision was +2. The antero-posterior and transverse diameters of the globe are both increased. The greatest lengthening is in the ciliary region between the ora serrata and the anterior limit of the ciliary body. There is a cicatrix near the centre of the

cornea, to which the lens capsule is adherent (Fig. 4). The lens itself is in greater part absent, only some of its cortical matter

FIG. 4.—Specimen 26, showing adhesion of lens capsule to cornea, complete absence of iris and cupping of the optic disc. × 2½.

remaining. The iris is entirely absent. The ciliary body is much stretched and atrophied. Microscopically, the anterior of the ciliary processes are found drawn forwards, and in contact with the periphery of the cornea, blocking the filtration area. There are several extensive patches of choroidal atrophy. The optic disc is deeply cupped.

(Recorded in Ophth. Review, vol. x, p. 105.)

No. 27.—The outer half of the left eye of a man, aged 61, which five weeks previous to its removal was struck by a chip of cast iron. The tension at the time of removal was +1. There is extensive deep ulceration and yellow infiltration of the cornea. The whole anterior chamber is full of purulent exudation and blood clot; it is very deep, owing to the displacement backwards of the iris and lens. The iris near its root passes almost vertically backwards. The vitreous is shrunken and detached anteriorly from the suspensory ligament (Fig. 5), and posteriorly from the ora serrata up to the optic disc, to which structures it retains its attachments. The optic disc is cupped.

There is slight lateral detachment of the retina; possibly this has occurred since removal.

Fig. 5.—Specimen 27, showing ulceration of cornea, exudation into anterior chamber, displacement backwards of iris and lens, and detachment of the vitreous antero-laterally and posteriorly. × 2½.

No. 28.—The outer half of the right eye of a man, aged 24. Sixteen years previous to excision it had been wounded by a piece of broken jam-pot, and was operated on immediately afterwards. The sight was completely destroyed. During the last year he had had several attacks of pain in it, and symptoms of sympathetic irritation in the other eye. There is a cicatrix in the upper part of the cornea extending into the sclerotic, to which the iris is adherent. A portion of the lower part of the iris has been removed, and probably the lens also, for it is absent. The retina is extensively detached, remaining adherent only at the optic disc and ora serrata. In front it is indistinguishably blended with the much shrunken vitreous. There are a considerable number of pigment patches in it, and a cyst protrudes from its outer surface. The uveal pigment layer presents a very granular appearance from numerous colloid nodules scattered throughout it.

No. 29.—The lateral half of a somewhat shrunken eyeball, flattened from before backwards; nothing is known of the his-

tory, except that sometime previous to removal it had been injured by a shot. The aperture of entrance of the shot through the cornea is not shown. The anterior chamber is of good depth. The lens is shrunken, and rounder than normal, its cortex being opaque and grey. Proceeding from its posterior pole to a little on one side of the optic nerve, is a dense band of cicatricial tissue, which, by its contraction, has caused the flattening of the eye above mentioned. Where this cicatricial tissue meets the sclerotic there has evidently been a perforation in it, the aperture of exit of the shot from the eye. The retina is completely detached from the choroid, and the choroid from the sclerotic anteriorly.

No. 30.—The inner half of the left eye of a girl, aged 9. A fortnight previous to removal it was wounded by a thorn. There is a small perforating wound, with yellow margins, in the lower and inner quadrant of the cornea. The lens at the seat of section appears normal. There is extensive purulent infiltration of the vitreous; it is somewhat shrunken, and detached posteriorly except at the optic disc. Above, it has become adherent to the retina, and by its contraction is dragging the latter away from the choroid. Below, there is purulent material between the detached hyaloid and the retina.

No. 31.—The outer half of the left eye of a boy, aged 16. Four months previous to excision he was opening a lemonade bottle, which burst, a piece of the glass cutting the eye. Extending from near the middle of the lower margin of the cornea, outwards to beyond the insertion of the external rectus muscle is a depressed scar. On the inner surface of the globe this shows as a broad, white, thickened band. The retina around it is puckered. The lower margin of the lens is displaced forwards and downwards. The vitreous is much shrunken.

No. 32.—The inner half of the right eye of a boy, aged 10. Eighteen days previous to its removal it was wounded by an arrow. There is a Y-shaped cicatrix in the cornea, the foot of the Y extending from the centre inwards. The iris is adherent to the cicatrix. The lens is opaque and small; extending from its posterior and inner part, backwards and inwards to the

retina, at a point equidistant between the ora serrata and the optic disc, is a round band. The retina where this is inserted is rucked. The vitreous is shrunken and detached posteriorly; there is a hæmorrhage in it at the lower part.

No. 33.—The inner half of the right eye of a boy, aged 9. He was cutting a piece of wood about three weeks previous to excision, and the knife slipped up into the eye. At the time of excision the tension was increased, and there were numerous small dots on the back of the lower part of the cornea. There is a recently healed wound extending horizontally across the upper part of the cornea, and greyish dots of deposit can be seen on the posterior surface of its lower part. The lens is adherent to the corneal wound, and its upper part has either escaped or been absorbed. The vitreous is drawn forwards; it is detached from the retina posteriorly, and from the suspensory ligament at the lower part anteriorly.

No. 34.—The inner half of the right eye of a boy, aged 4 years. Eight days previous to its excision he ran a fork into it. The wound, with slightly infiltrated margins, is seen passing through the cornea a little above its centre. To this the anterior capsule of the lens is adherent, the iris being drawn forwards in front of it, and the anterior chamber is shallow. The lens has evidently been perforated from before backwards; it is opaque, and a faint yellowish track can be traced through it. In the lower and anterior part of the vitreous is a mass of suppuration with a sharply-defined margin. Posteriorly it is detached from the retina.

No. 35.—The inner half of the left eye of a boy, aged 3. Four months previous to its removal it had been wounded with the prong of a toasting fork. In the upper part of the cornea one limb of a triradiate cicatrix is seen. The lens is absent. The iris is thickened. The vitreous is much shrunken and fibrous; it is intimately adherent to the retina, which is extensively detached. It passes forwards from the optic disc as a stalk, and terminates in a folded mass anteriorly. From the lower part of this a second stalk-like portion is seen to project, and to be inserted about the equator of the globe.

No. 36.—The inner half of the left eye of a boy, aged 13. Eighteen months previous to excision he ran a knife into it. In the sclerotic, 5 mm. distant from the lower corneal margin, is a depressed cicatrix. The edges of the wound are seen to have become inverted, a band of cicatricial tissue passes from it to the lower margin of the lens, which by its contraction it has drawn downwards. The lens is opaque and shrunken, there are patches of dense white opacity at its anterior pole and lower border. A membrane stretches across the globe behind the lens, probably a remnant of the vitreous. To the cicatricial tissue about the wound a fold of puckered retina passes forwards and is adherent; elsewhere it is *in situ*.

No. 37.—The inner half of the right eye of a boy, aged 2. The only history respecting it is that he fell on a form and wounded it. At the lower and outer margin of the cornea was a small bulging cicatrix, this is not shown in the specimen. The anterior chamber is very shallow, and a yellow membrane fills the pupil. The whole vitreous is a mass of suppuration; it is shrunken, and being intimately adherent to the retina, has detached it from the optic disc up to the ora serrata, by its contraction. Above, the suppuration in the vitreous has broken through the retina, and is protruding into the sub-retinal space. Below, there are extensive blood clots between the detached retina and choroid.

No. 38.—The outer half of the right eye of a man, aged 29, which was wounded by a nail eleven days previous to removal. An imperfectly closed wound, with slightly infiltrated margins, is seen extending horizontally across the cornea. A small piece of the iris has been removed from the outer side. Lymph extends from the posterior surface of the wound, and unites the anterior capsule of the lens to it. The present dense white appearance of the lens is due to the hardening reagent. The vitreous is much shrunken and detached posteriorly; the retina is in position.

No. 39.—The lateral half of the right eye of a man, aged 56. It was wounded by a stone fourteen days previous to removal. At the upper corneal margin is an unclosed wound, with a prolapse

of the upper part of the iris through it. The anterior chamber is shallow and a yellow membrane fills the pupil. The lens is of normal size and shape. There is extensive purulent exudation into the vitreous, chiefly in the ciliary region anteriorly, and in the peripheral parts posteriorly, where it is intimately adherent to the retina. The central portion is opaque, but free from yellow infiltration. The optic disc is much swollen.

No. 40.—The inner half of the right eye of a man, aged 43. Three months before excision it was injured by a chip of coal. An ulcer of the cornea followed, accompanied by hypopyon, and the tension became increased. In spite of treatment the ulcer perforated, the iris prolapsed and the lens escaped. There is considerable thickening and infiltration of the cornea around the seat of perforation, which has now closed. The lower part of the iris and lens capsule are adherent to it. The vitreous is drawn forwards and detached posteriorly from the retina, which is in position.

No. 41.—The lateral half of a wounded eye of which there is no further history. On one side of the cornea the track of a recent wound is seen with some lymph in it; the pupillary border of the iris in its neighbourhood is adherent to it. It passes to one side of the lens through the circumlental space into the vitreous. In the latter there is a complete ring of purulent infiltration, which is thickest in the neighbourhood of the wound.

No. 42.—The lateral half of the right eye of a lad, aged 17. Two years previous to its removal it was wounded by a sharp stone, and the sight was lost. Subsequently it had enlarged, and the tension at the time of excision was +2. The antero-posterior diameter of the globe measures 31·5 mm., the vertical 26·5 mm. The diameter of the cornea is 16·5 mm.; it is leucomatous and very thin: intimately adherent to the whole of its posterior surface is the atrophied iris, which is spread out in the form of a network of pigment on it. The lens is absent; its capsule is seen partly stretching across the globe with a little of the cortical substance still in it. The vitreous is much shrunken and detached; posteriorly it has

blood clots in it. The retina is in position, and the optic disc deeply cupped.

No. 43.—The front half of the right eye of a boy, aged 13, from which the cornea and sclerotic have been removed. Eight days previous to excision it was struck with an awl. A little below the centre of the cornea was a grey scar with infiltrated margins. The lens is opaque; a portion of it, which was adherent to the corneal scar, is seen projecting forwards. The pupillary margin of the iris has been cut across, and there are some posterior synechiæ. There is some purulent infiltration of the vitreous.

No. 44.—The two halves of the right eye, divided by an antero-posterior section, and mounted in one cell. It was removed from a man aged 37, who a fortnight previously had wounded it with a piece of rivet. There is a widely gaping perforation at the anterior part of the globe, through which the greater part of its contents has escaped and the retina is prolapsing. There is a purulent mass between the retina and choroid. The orbital tissues are intimately adherent to the external surface of the sclerotic, and a good deal has been removed along with the globe.

Subseries (D).—*Eyes Wounded and containing a Foreign Body.*

Any hard substance, provided it is propelled with sufficient force, may become lodged within the eye. By far the most common foreign bodies to find thus situated are chips or scales of steel or iron (Nos. 3, 7, 9, 10, 11, 12, 13, 14, 18, 19, 20 and 21). Others shown in the specimens in this collection are:—Fragments of stone (Nos. 5 and 17); a tin-tack (No. 1); a piece of wood (No. 2); a piece of coal (No. 4); a shot (No. 6); a piece of glass (No. 8); a piece of lead (No. 16); eyelashes (Nos. 15 and 22).

Pieces of steel which have remained in the eye for a long time show signs of oxidation on the surface (Nos. 14

and 18). Foreign bodies may be met with embedded in any of the structures of the eye; they are very frequently found in the vitreous. When they become loose in it, they tend to gravitate to its lowest part, and rest on the posterior part of the ciliary body (Nos. 5, 10, 12, 13, 16, 17 and 20). Sometimes a foreign body having perforated the globe, will pass on and strike the back of it, but not with sufficient force to pass through its walls a second time, or to become implanted in them; it will then rebound and sink down in the vitreous. That this series of events has occurred is shown by the track of the foreign body being traced to a spot at the back of the globe, where its tunics have been bruised or become adherent, while it itself is resting on the lower part of the ciliary body (Nos. 10 and 17). A foreign body that lodges in the lens is more readily tolerated than elsewhere, and may remain there for years without causing symptoms which necessitate its removal (Nos. 14 and 18); this is doubtless due to its non-vascular and nerveless structure.

Occasionally, in wounds of the eye, the instrument which inflicts the injury carries one or more eyelashes, or a piece of epithelium in with it; these may lodge either in the corneal wound (No. 15), or in the anterior chamber (No. 22). Eyelashes which have been carried into the anterior chamber have been seen to have small tumours starting from their root sheaths, composed of laminated epithelial cells; and portions of epithelium implanted in the interior of the eye grow either into solid, pearl-like tumours, or into cysts lined by laminated epithelial cells.

The amount and the character of the inflammation excited by a foreign body lodged in the eye varies considerably, according to the quantity and nature of any septic material adhering to it; also with the chemical constitution of the body itself. Occasionally it causes a rapidly ensuing suppurative panophthalmitis (No. 21). More commonly it gives rise to a chronic plastic uveitis, with exudation into the vitreous, often resulting in shrinking

of the globe, and the formation of bone on the inner surface of the choroid (Nos. 14 and 19). This kind of inflammation may extend to the other eye, constituting what is known as sympathetic ophthalmitis. In other cases the exudation of leucocytes is of so trivial a character as to give rise to only the encapsulment of the foreign body, or the absorption of blood clots incident on its entrance.

No. 1.—The anterior half of the eye of a boy, aged 12. Two days previous to its removal he was getting over some iron railings (horizontal bars with wooden steps, forming a stile), when he fell, the eye, he thinks, striking the top bar. At the upper and outer margin of the cornea is a gaping wound, with a yellow mass prolapsing through it. Lying in the anterior portion of the turbid vitreous is a complete tin-tack. A thick layer of blood clot separates the sclerotic from the choroid.

(Recorded and figured in R.L.O.H. Reports, vol. xii, p. 305.)

No. 2.—The anterior half of an eye, divided nearly into two by an antero-posterior section, the parts being left joined together in the neighbourhood of the wound. It was removed from a man who, seven weeks before, had received a thrust in it from a bamboo stick. There is a wound in the sclerotic just behind the insertion of the superior rectus tendon; lying in it is a piece of bamboo stick half an inch long, and as thick as a wooden match. The splinter passes backwards and a little downwards, towards the centre of the eye, but has not perforated the choroid. It was surrounded by a thick layer of yellow lymph, on the inner surface of which again was the choroid; it has been partly exposed by removing these, its inner coverings.

No. 3.—The two lateral halves, preserved in separate cells, of the eye of a boy, aged 2. It was wounded by a piece of steel, four months before excision. The cornea shows a linear scar, extending from a little beyond its centre to its junction with the sclerotic. The anterior chamber is deep and the iris thickened. The condition of the lens cannot be seen from being hidden by the ciliary processes. The ciliary body is detached somewhat from the sclerotic, a layer of buff-coloured, new, fibrous-looking material intervening. The retina is detached except at the

optic disc and ora serrata, and thrown into folds. The hyaloid fossa contains a mass of opaque, whitish tissue, in which is embedded a blackish chip of steel.

No. 4.—The two lateral halves of a shrunken eye, mounted in separate cells. The cornea shows a puckered scar, extending right across it. The iris is irregularly thinned, and in contact throughout with the cornea, the anterior chamber being abolished. The lens is absent, its capsule still remaining. The retina is extensively detached from the upper half of the eye and drawn downwards in irregular folds towards the lower part; it remains attached to the optic disc and ora serrata. Towards the lower part the folds of the retina have become more or less matted together, and attached to patches of choroid by inflammatory material; imbedded in this thickened retina and inflammatory subretinal effusion are several small pieces of coal. It is difficult now to determine how much of the pigmentation in the retina and on the choroid is due to coal, and how much to uveal pigment.

No. 5.—The inner half of the eye of a man, aged 36. It was wounded by a piece of stone, two months before excision. At the time of removal it showed a scar in the lower and outer part of the cornea, with a tag of iris adherent, the area of the pupil being occupied by a white substance. The adhesion of the iris to cornea can be seen in the specimen; the anterior chamber is deep. The lens is absent, its capsule remaining thickened and opaque. Lying on the ciliary processes at the lower part is seen a foreign body, with some fibrous tissue around it. The retina and choroid are in their normal position, and apparently healthy.

No. 6.—The anterior half and a portion of the posterior half of an eye mounted in separate cells. The patient from whom it was removed was a man, aged 40; three years previously the eye had been wounded by a small shot. The cornea is clear; just outside its margin, on one side, there is a slightly pigmented scar in the sclerotic. There is a rent in the iris about 2·5 mm. long, opposite the scar; it does not involve the sphincter pupillæ, but extends outwards to the ciliary processes. Lying partly in the wound, and partly upon the ciliary processes, is a small shot.

It is quite clean, except at its inner side, where it touches the margin of the lens; here it has become slightly corroded, and a small, opaque, white patch has formed, involving the outer surfaces of both lens and shot. The lens was quite transparent, but has now become partly opaque.

No. 7.—The lateral half of an eye wounded by a piece of iron. The lens is absent, probably removed purposely. The foreign body, a fragment of blackened iron, is seen near the optic disc, imbedded in a quantity of inflammatory tissue between the retina and choroid. The retina is detached, except around the optic disc, as far forwards as the ora serrata; it has a number of pigmented lines running in it in an antero-posterior direction. There is some irregular disturbance of the uveal pigment layer.

No. 8.—A considerably shrunken eye, the greater part of the outer half of which has been cut away to expose a foreign body *in situ*. It was removed from a young woman, aged 18, who received a severe wound of it in a gun-cotton explosion six weeks previously. At the time of the excision it was quite blind and painful, and her other eye was irritable. A scar one-third of an inch long, running vertically through the upper part of the cornea and adjacent sclerotic has just been left in the specimen. The lens is absent; it no doubt escaped through the wound at the time of the accident. Lying in the vitreous chamber is a triangular flat piece of glass. It measures 18 mm. perpendicularly, and 10 mm. at its base. Its apex points downwards and outwards, having perforated the retina and probably the choroid; it lies in contact with the sclerotic, close to the insertion of the inferior oblique muscle. The glass is kept firmly in its place by the pressure of the sclerotic against its base and apex.

No. 9.—The shrunken eye of a boy, aged 14. Part of the coats of the eye have been cut away, to show the foreign body embedded in it. A fortnight before its excision it was struck by a chip of "hot steel." The sharp point of the piece of metal is seen protruding through the sclerotic in the yellow spot region; its other end lay against the inner surface of the sclerotic in the outer ciliary region, close to the wound of

entrance. The chip, which is irregular in shape with very jagged edges, measures 24 mm. in length, and 9 mm. at its widest part.

No. 10.—The lateral half of the right eye of a man, aged 42. A year previous to its removal it was struck by a chip of iron. Three months later two large areas of disease were seen in the nasal half of the fundus: at that time it was thought that one was the aperture of entrance, and the other the aperture of exit of a foreign body. What ultimately determined removal of the eye was a severe attack of iritis. The cornea and lens appear normal. In the equator of the globe, at a point corresponding to the scar of an external wound beneath the internal rectus muscle, a small, white spot is seen, where all the tunics are apparently adherent. From this spot, running slightly upwards and backwards, is a fold in the retina, which terminates in a larger white patch with a pigmented margin and slight central depression. This patch is situated up and out from the optic disc. Lying on the lower part of the ciliary body and covered partly by some white, flaky substance, and partly by blood clots, is a black piece of metal, 3 mm. long and 1 mm. broad. The inference is that the piece of metal entered the eye at the small spot in the equator, struck the back of the globe at the site of the large white patch, and then, becoming free in the vitreous, sunk to its lowest part, and came to lie on the ciliary body.

(Recorded in R.L.O.H. Reports, vol. xii, p. 339.)

No. 11.—The lateral half of a right eye, from which the sclerotic and choroid have been partly cut away on one side to show the position of a foreign body. Five months previous to its excision, the eye was struck with a piece of metal, which flew up while the patient was cutting a rivet. During the last fortnight his left eye had exhibited symptoms of sympathetic irritation. There is a puckered cicatrix at the upper part of the cornea and iris. The foreign body, which is a flat piece of steel 12 mm. long, lies obliquely in the anterior portion of the vitreous chamber. It is encapsuled by the completely detached retina and fibrous tissue. At the lower part of the globe, 6 mm. distant from the margin of the optic nerve, it protrudes through the sclerotic. The lens is opaque and shrunken.

No. 12.—The inner half of the right eye of a man, aged 50. He could give no definite history of any injury, but he said he frequently got "bits" in his eyes at his employment as a bricklayer. He had had slight attacks of dimness and pain in the eye for some months. Six weeks previous to excision it became inflamed and intensely painful; since that time the sight gradually failed. On a large, circular patch of atrophied choroid, situated at the lower part of the eye just posterior to the ora serrata, lies a foreign body, which, from its rusted appearance, is presumably a piece of steel. It is about the size of a pin's head. The fibres of the suspensory ligament at the lower part are torn through; this allowed the lens, which appears normal, to sway backwards and forwards. Since the eye was opened the lens and iris have become displaced backwards; at first the root of the latter was in contact with the cornea constricting the angle of the anterior chamber. The retina is *in situ*. The optic disc is cupped.

No. 13.—The inner half of the left eye of a young man, aged 17. Eight days previous to excision he was chipping a piece of steel with a hammer and chisel, and a bit flew up and struck his left eye. He was under the impression that the piece did not remain in the eye but fell down again. The following day the electro-magnet was used through the wound, which was in the lower and outer part of the cornea extending into the sclerotic; no foreign body was found. A portion of the iris which prolapsed was snipped off. The wound does not show in the specimen. There is some blood clot in the lower part of the anterior chamber. The lens is in position: there is some opacity of its lower part. Behind the lens in the vitreous, resting on the ciliary body, is a large triangular piece of metal, surrounded by some yellow lymph. The retina is *in situ*, but slightly rucked. The optic disc is swollen.

No. 14.—The two halves of a left eye opened by an antero-posterior vertical section and mounted in one cell. It was removed from a man, aged 47, and had been injured by a chip of steel twenty-eight years previously. The sight went directly after the accident. The cornea has a calcareous opacity in it at its lower part, where an adhesion of fibrous tissue passes

between it and the iris. The pupil is filled with a fibrous membrane. The lens is shrunken and displaced downwards; lying in it is a piece of metal which has been cut in two in making the section of the globe. The retina is completely detached from the optic disc to the ora serrata; it is much shrunken, and forms a thin round cord passing through the centre of the globe. The pigment epithelium is much atrophied; on the inner surface of the choroid round the optic nerve is a plate of bone.

(Recorded in Ophth. Review, vol. xi, p. 140.)

No. 15.—The front half of the eye of a boy, aged 4½. It was injured by a stone five days previous to excision. A wound extends from about the centre of the cornea inwards, across its margin into the sclerotic. There is a prolapse of a part of the iris. Lying in the wound half in and half out is an eyelash.

No. 16.—The inner half of the right eye of a man, aged 29, who stated that nine months previous to excision it had been wounded by a splinter from a leaden bullet on a rifle range. There is a cleanly cut, curved scar in the cornea, to which the iris is adherent. The anterior chamber contains a large blood clot at the lower part. The lens is shrunken and flattened antero-posteriorly. The retina is *in situ*. Immediately above the optic disc is a small, circular, depressed spot with a pigmented margin. The optic disc is deeply cupped. Lying on the ciliary body at the lower part of the globe is a narrow strip of lead 8 mm. long.

No. 17.—The two halves of an eye, opened by an antero-posterior vertical section, and mounted in one cell. It was removed from a patient, aged 66, and had been struck five weeks previously by a piece of stone. There is a small scar in the cornea at its upper and inner margin, and an irregular notch in the iris up and in. The lens is large and more globular in shape than normal; it has streaks of opacity in it, and a light band passing horizontally across it a little behind the nucleus. The vitreous is shrunken and detached everywhere posteriorly, except at a point about 3 mm. internal to the optic

disc, where there is a tag of adhesion; this is probably the position at which the foreign body struck the back of the globe. The foreign body is a triangular piece of stone; it is seen lying on the lower part of the ciliary body, with some blood clots around it.

No. 18.—The outer half of the right eye of a man, aged 46. Twenty-six years previous to excision it was injured by a piece of steel; the sight failed gradually, and for fifteen years the eye had been quite blind: during the last month it had been painful. There was a small scar in the lower part of the cornea; this is not shown in the specimen. There is a hole in the lower part of the iris, and an absence of uveal pigment from its posterior surface in the neighbourhood. Suspended by a thin tag of grey membrane, which is adherent to the upper portion of the ciliary body, is a small piece of steel which, except for this attachment, floats free in the vitreous. Probably it originally lodged in the lens, which has become absorbed from around it, and the bit of grey membrane now attached to it is a remnant of the lens capsule. The pigment layer of the retina and the choroid are much atrophied, the large vessels of the latter being distinctly seen. There are numerous little scattered patches of pigmentation in the retina.

(Recorded in Ophth. Review, vol. xi., p. 140.)

No. 19.—Two thin plates of bone preserved dry and stuck together by some remnants of soft tissues. They were removed from the inner surface of the choroid of the eye of a man, aged 28. Five years previous to excision he had had it struck by a small piece of steel. An attack of inflammation set in three and a half years later, since which time the eye had been painful on and off. Between the two pieces of bone, lying on their inner surface, is a small chip of metal, painted red to make it more conspicuous. The larger and posterior of the two pieces of bone is curved, smooth on the outer surface, irregular on the inner. About its centre, the thinnest part, are two holes, one evidently for the optic nerve. The smaller and anterior piece, which lay on the inner surface of the ciliary body is smooth on the inner surface and irregular on the outer.

No. 20.—The front half of an eye, removed from a man

aged 51. Two and a half weeks previous to excision he was hitting a piece of steel with a hammer, and a bit flew up and struck the eye. The small chip of steel can be seen lying on the inner surface of the retina, just at the ora serrata in the lower part. There are some nodules of lymph in the vitreous around it. The lens is partially opaque; there is a gap in its posterior capsule through which it is partially extruding. In the reflection in the mirror behind the specimen, a small hole in the lower and outer part of the iris can be seen.

No. 21.—The two lateral halves of a left eye mounted in one cell. It was removed from a boy, aged 13, who stated that nine days previously, while he was hoeing, a piece of stone flew up and struck it. No perforation can be seen in the cornea or sclerotic. There is a quantity of pus in the anterior chamber. The lens, when the eye was first opened, was quite clear, but it has become opaque in the process of hardening. There is a mass of pus in the lower part of the vitreous over the ciliary body, embedded in which a small chip of metal was found; this is now seen lying separate from the eye. The remainder of the vitreous has streaks and dots of yellow infiltration in it. The retina is in position.

No. 22.—The front half of the left eye of a girl, aged 8, from which half the cornea has been cut away. Six days previous to its excision it was wounded by a piece of glass. Passing vertically across the whole cornea, and slightly into the sclerotic above, is a ragged wound with slightly infiltrated margins. A portion of the iris and wounded lens are prolapsing. Lying in the anterior chamber in front of the lower and inner part of the iris is an eyelash.

Subseries (E).—*Burns, Scalds, and the action of Chemical Agents.*

Burns, lime and mineral acids are very similar in their effect upon the eye. The amount of damage varies with the heat of the substance, the strength of the lime, or acid, and the length of time it has been in contact. If the

epithelium is alone destroyed, it will be reproduced without any scarring, and the transparency of the cornea will not be affected. Usually the deeper structures are also involved, and considerable sloughing follows. The corneal tissue at the sides of the ulceration becomes opaque from inflammatory infiltration of it (No. 3). When the sloughs have separated, the contraction which occurs in the process of cicatrisation is very great, large portions of conjunctival tissue being drawn over the cornea (Nos. 3 and 4), so that it often appears clinically to be much reduced in size, though its posterior parts really retain their normal dimensions. When there is ulceration on both the inner surface of the eyelid and the front of the globe, the granulation tissue on the two sides unites, and what is termed a *symblepharon*, or adhesion of the lid to the front of the eye, is formed, sometimes extending to the cornea. In severe cases of burn, perforation of the cornea may take place, with escape of some of the contents of the eye (Nos. 1 and 2); this may be followed by detachment of retina and inflammation of the uveal tract, the other eye occasionally becoming sympathetically inflamed (No. 2).

No. 1.—The two halves of an eye, partially separated by an antero-posterior section, but still adherent anteriorly. Two years previous to excision it was injured by a burn, and repeated attacks of inflammation followed. The cornea is opaque, and the iris cannot be identified. The lens is now absent; there is no note as to whether it was present when the eye was opened. The vitreous is shrunken and the retina is detached; between the retina and choroid there is a layer of firm, white, slightly translucent tissue looking like cartilage. Between the choroid and sclerotic there is, at the equator, a thick layer of brownish tissue; where this is thickest there is hollowed out in it a smooth-walled cavity as large as a hemp seed. The sclerotic is much thickened.

No. 2.—The lateral half of the right eye of a man, aged 46. Seven weeks previous to its excision he had a splash of lime in

it: the other eye developed sympathetic ophthalmitis. The globe is diminished in diameter antero-posteriorly. The cornea is much shrunken, and has some conjunctival tissue attached to its anterior surface. The iris is intimately adherent to the cornea. The lens and vitreous have in great part escaped. The retina is detached; anteriorly it is much puckered and apparently adherent to the cornea. The choroid is detached equatorially, and the sclerotic is thickened.

No. 3.—The front half of the left eye of a man, aged 24. Seven years previous to its removal it was burnt with hot metal, and a symblepharon formed. To the upper part of the cornea a large portion of conjunctiva is still adherent, the remainder of it is leucomatous. The anterior chamber is of good depth and the lens is *in situ*.

No. 4.—The inner half of the left eye of a woman, aged 63. When she was 15 years old it was burnt with a squib; recently it had become inflamed and painful. There is extensive adhesion of conjunctiva-like tissue to the outer surface of the cornea. The lens and iris appear normal; the vitreous is much shrunken and detached posteriorly. There is some thinning and bulging of the sclerotic around the optic nerve.

Subseries (F.)—*Operations.*

Of the old operation for displacement of cataract there were two varieties, depression and reclination. The latter, the more severe operation because of the extensive laceration of the vitreous necessary, was claimed to be the more effectual, because in the former there was a considerable tendency for the lens to reascend (No. 3).

A chronic inflammation of the iris and ciliary body was by no means an infrequent sequela, which would lead to effusion into and subsequent shrinking of the vitreous and detachment of retina (Nos. 2 and 3).

The relative alteration in the position of the lens and vitreous body would often press forwards the iris, giving

rise to obstruction to the exit of fluids at the angle of the anterior chamber, and increased tension with its accompanying manifestations (No. 4).

In eyes upon which the operation of extraction of cataract has been performed, entanglements of the iris (Nos. 5, 13, and 14) or lens capsule in the wound are very common. Adhesions of them to it also form when for some reason the anterior chamber has been slow in re-forming, or has been reopened by the patient having accidentally rubbed the eye (Nos. 14, 15, 16, 17, 18, 19, and 22). Then the exudation thrown out to close the wound glues either the lens capsule or iris to it. Eyes in which the lens is extracted without any iridectomy being done, are more likely to have the iris, and less likely the lens capsule entangled, than when a portion of the iris has been removed.

The lens capsule, when entangled in or adherent to an extraction cicatrix, becomes drawn into a much more advanced position than that which it normally occupies. The iris lying in front of it is also drawn forwards and its root approximated to the posterior surface of the cornea; sometimes they even come into apposition, in which case the exit of fluids through the filtration area becomes blocked, and the tension of the eye becomes increased (Nos. 15 and 18).

The tension may become increased even though an iridectomy has been performed, for in extraction of cataract it is not usual to tear the iris away from its extreme periphery, so that sufficient of the root is left to block the filtration area in the situation of the coloboma, when drawn forwards. A lens capsule which is adherent to an extraction cicatrix may, as the band of tissue which unites them organises and contracts, be gradually advanced more and more in position, and the tendency to the narrowing of the angle of the chamber gradually increased; in such a case the increased tension might not come on until some time after the operation (No. 18).

Sometimes no increase of tension comes on until after a needle operation, in which case the attack may be induced by a second adhesion at the needle puncture, or by swelling of some cortical lens matter left in the capsule from the action of the aqueous on it, or possibly by congestion of the ciliary processes (No. 17). The fact that a hole has been made in the centre of the capsule does not affect its position or that of the iris (No. 17), consequently it does not tend in any way to re-establish the arrested circulation of fluid.

Besides drawing forwards the iris, an entangled or adherent lens capsule, through its suspensory ligament, causes considerable drag on the ciliary body, which would be likely to cause congestion of it, to increase its amount of secretion, and to predispose it to inflammation.

Inflammation of the uveal tract after extraction of cataract, commencing as serous cyclitis, is usually found associated with such a synechia of lens capsule. In these eyes increased tension is commonly met with (Nos. 16 and 19), not entirely due to blocking of the filtration area by the root of the iris, but partly to accumulation of formed inflammatory products in the mesh of the ligamentum pectinatum, and an increased secretion. Eyes in which, after extraction of cataract, a plastic or serous inflammation of the uveal tract comes on with increased tension, are particularly liable to excite sympathetic ophthalmitis in the other eye (Nos. 16 and 19).

When the lens has been removed in its capsule the vitreous may come forward and be adherent to the extraction scar; in such a case the iris is more drawn forwards than when the capsule is attached to it, and increased tension more likely to ensue (No. 21).

As in other perforating wounds, so in those caused by operations, a portion of epithelium from the surface of the cornea may be carried in before the knife and implanted into the anterior chamber, where, subsequently proliferating, it will give rise to a cyst lined by laminated epi-

thelial cells. Such a cyst, forming in a coloboma after the extraction of a cataract, will block the passage of fluids through it, which will then collect behind the iris and push it into contact with the cornea and cause increased tension (No. 20).

Suppuration after operations is now, owing to the greater precautions taken to render the instruments employed aseptic, of much less frequent occurrence than formerly. It varies in extent, sometimes being confined to the anterior portions of the eye (Nos. 11 and 13), at others involving the whole of its structures (Nos. 8 and 12). Suppuration, on rare occasions, may ensue after an iridectomy (No. 35); it is more frequent after an extraction of cataract (Nos. 8, 11, and 12), or a needling.

The lens matter left after a cataract operation forms an excellent medium for micro-organisms to grow in, should they find access to the eye. It is rare for a lens to be extracted completely; a collar of cortical matter is usually left enclosed in the periphery of the capsule, its size varying with the relative maturity of the cataract at the time of the operation (Nos. 11, 13, 14, 15, 16, and 18).

Changes are met with in eyes which are removed after extraction of cataract which are due to the organisation and contraction of inflammatory products. The iris is sometimes found intimately adherent to the lens capsule, which may be thickened by fibrous tissue, so that the two together form a dense partition between the vitreous and aqueous chambers (Nos. 15 and 22). The formation and contraction of fibrous tissue in the anterior portion of the vitreous may cause depression of the cicatrix, and separation of the ciliary body from the sclerotic (No. 10). Shrinking of the vitreous and detachment of the retina also occur (Nos. 6, 8, and 9).

After a needling operation a tag of lens capsule or vitreous occasionally becomes adherent to the cornea at the point of puncture; this is most likely to happen when the aqueous is allowed to escape, especially if it should

come out with a gush on the withdrawal of the needle (No. 14).

Severe hæmorrhage, coming on shortly after an operation on the eye, is more commonly met with when an iridectomy for glaucoma has been performed than when a cataract has been extracted, though it does occasionally occur after the latter operation (No. 7). The sudden relief of tension causes rupture of some of the blood vessels, in eyes in which they are abnormally brittle from changes in their walls. The hæmorrhage is always most extensive from the vessels of the choroid, it and the retina becoming detached from the sclerotic, and the lens and vitreous being forced out through the wound (Nos. 23, 24, 25, 32, and 34).

An iridectomy for glaucoma may fail to relieve tension, from the iris not having been removed sufficiently near its periphery to open up the blocked filtration area of the cornea (Nos. 29, 31, and 33). In glaucoma of long standing this is often a physical impossibility; the root of the iris, when it has been in contact with the cornea for some time, becomes so intimately adherent to it that it cannot be torn away. On account of the oblique direction of the sclero-corneal margin, the periphery of the iris is not visible through the cornea externally, and it is possible for a considerable portion of it to be left which would not be seen clinically.

A knuckle of iris tissue sometimes becomes incarcerated in an iridectomy or sclerotomy incision and prevents it from closing throughout its whole thickness; this then becomes a weak spot in the tunics of the globe, and, on re-accumulation of the intra-ocular fluids, is liable to bulge and become what is known as a *cystoid cicatrix* (Nos. 26 and 28).

Adhesion of the lens capsule to the iridectomy cicatrix is another occasional cause of failure of an iridectomy for glaucoma; the adhesion may result from a wound of the lens (No. 30), or from delay in the re-formation of the anterior chamber.

The operation of abscission was devised to reduce the deformity and inconvenience arising from an anterior staphyloma, and to leave an elastic bulb freely influenced by the muscles inserted into it, over which an artificial eye could be worn. The amount of the front of the globe removed varied with the extent of the enlargement; sometimes a considerable portion of the ciliary body was left (Nos. 36 and 37). This operation has now been abandoned, as cases of sympathetic ophthalmitis have been known to occur after it.

No. 1.—The front half of an eye from which a segment of the tunics, including the ciliary processes, has been removed from the upper part. Two years previous to its excision the operation for depression of cataract had been performed upon it. There are no visible signs of disease in the vitreous, retina, choroid, or sclerotic. The ciliary processes also look normal. The nucleus of the lens was imbedded in the vitreous near the upper ciliary processes, but now lies loose by the side of the preparation; it is amber-coloured. The lens capsule is thickened, and still contains at its periphery a good deal of grey, opaque lens substance.

No. 2.—An eye from the upper part of which the choroid and sclerotic have been removed. The operation for depression of cataract was performed upon it in September, 1857. Inflammation followed the operation, and the eye was removed in May, 1858. The retina is detached in the form of an irregular cone as far as the ora serrata. Fluid containing cholesterine escaped from the subretinal space on opening the eye. The uveal pigment layer on the inner surface of the choroid appears granular. The whole posterior surface of the iris is glued to the lens capsule. Between it and the detached retina is a mass of whitish, fibrous-looking tissue, contained in which are portions of soft lens matter.

No. 3.—An antero-posterior ring-section from the centre of an eye of a woman, aged 55, upon which an "Indian doctor" nine months previously had operated for cataract. The opera-

tion attempted—in all probability displacement of the lens—was followed by inflammation. The cornea is semi-opaque. The pupil is filled by an inflammatory membrane. The retina is completely detached, remaining adherent only at the optic disc and ora serrata; it forms a thick cord in the centre of the globe which expands anteriorly. The lens is opaque, and slightly displaced backwards; its posterior surface is intimately blended with the shrunken vitreous and detached retina, so that these structures can hardly be differentiated. The organisation and contraction of the inflammatory exudation into the vitreous have caused some detachment of the ciliary body from the sclerotic.

No. 4.—The lateral half of the left eye of a man, aged 62. Three years previous to its excision, it was operated upon by an Indian doctor for cataract. Vision had been retained until the last month, when an attack of pain set in, and the sight failed rapidly. The tension was increased. From the position of the lens there can be little doubt that the operation which was performed was that of depression; it is displaced in its capsule downwards. In mounting the specimen the nucleus, which is of a brown colour, has turned over; when the eye was first opened it was found with its anterior surface on the ciliary processes. The vitreous is shrunken and detached posteriorly: it comes forwards above the lens, and is in contact with the back of the iris; its hyaloid membrane does not appear to have been ruptured, but has been displaced backwards by the depression of the lens. The angle of the anterior chamber is not now restricted, nor does the optic disc appear cupped.

No. 5.—The two lateral halves of an eye, preserved in separate cells, from which a cataract had been extracted by the flap operation. The eye was probably removed *post mortem*. The extraction cicatrix in the cornea is very distinctly seen as an oblique pigmented line. The iris at the upper part probably prolapsed into the wound, a small portion of it being removed, the part of it which was left becoming incarcerated in the cicatrix. The lens is completely absent. The remaining portions of the eye appear normal.

No. 6.—The lateral half of an eye from which a cataract has been extracted. There is a pigmented scar in the cornea near the sclero-corneal junction, passing through its entire thickness almost at right angles to its surface. It is evidently the scar of a flap-extraction wound. No iridectomy has been done. The iris is everywhere in contact with the cornea. The lens is absent, and the retina detached in umbrella form.

No. 7.—An eye divided by an antero-posterior section into two unequal halves, mounted in one cell. It was operated on for cataract, the lens being extracted. There is no note as to the length of time which elapsed between the extraction and the excision. The cornea is partly separated from the sclerotic; probably this separation is the unhealed extraction incision. The iris is not clearly distinguishable. The choroid is separated by thick masses of blood from the sclerotic everywhere, except over an area $\frac{1}{3}$ inch wide having the optic disc for its centre. The retina is detached from the choroid, and its opposite surfaces are squeezed together; it remains attached at the optic disc; it is blood-stained and opaque.

No. 8.—The lateral half of an eye from which a cataract was extracted, the operation being followed by suppurative panophthalmitis. The bulging extraction cicatrix is seen at the upper corneal margin, purulent matter projecting between its lips. The upper half of the cornea is infiltrated and yellow. A purulent mass fills the anterior chamber; the iris is thickened and involved in this. The vitreous is converted into a mass of pus; it is difficult to distinguish the line of separation between it and the thickened suppurating retina. The choroid is extensively detached from the sclerotic, a coagulated, albuminous, partly purulent material lying between them.

No. 9.—The lateral half of an eye from which a cataract had been extracted, and in which subsequently an opaque membrane had been needled. This latter operation was followed by irido-cyclitis. The cornea is thickened at its upper part where the scar of the operation is situated. To it, at this part, some newly-formed fibrous tissue is adherent, and the anterior chamber is here obliterated. The iris at its upper part has been

removed. The retina stretches forwards from the optic disc as a rounded cord. Anteriorly it and the iris and the ciliary body are matted together into a firm greyish mass, which, by its contraction, has detached the choroid from the sclerotic. In the fluid which filled the space between the choroid and retina, cholesterine crystals were found in abundance; there were none in that between the choroid and sclerotic.

No. 10.—An antero-posterior ring-section from the centre of the eye of a woman, aged 61, who had had a cataract extracted from it three weeks previous to excision; the operation itself was uncomplicated, but it was followed by suppurative iritis, diminution of tension, and complete loss of vision. The cornea and the sclerotic, in the neighbourhood of the extraction scar, are considerably flattened inwards. This is evidently due to the contraction of some newly-formed fibrous tissue, which is adherent to the cicatrix, and passes across the ciliary region in the anterior portion of the vitreous. In its contraction it has also detached the lower part of the ciliary body from the sclerotic, causing marked enlargement of the suprachoroidal lymph space in that region. The upper part of the iris has been removed; the pupillary border of the lower part is nearly in contact with the extraction scar.

No. 11.—The lateral half of the eye of a man, aged 65, from which a cataract was extracted. The wound had to be enlarged with a secondary knife, otherwise the operation was uncomplicated. On the fourth day after the operation it became painful and inflamed. It was excised nineteen days after the extraction. The corneal wound is closed, but not firmly healed; there is no yellow infiltration about it. A portion of the upper part of the iris has been removed, but not up to its extreme periphery. There is some pus in the lower part of the anterior chamber. A large piece of lens matter has been left, which is yellow and infiltrated. The vitreous is opaque, and streaked with yellow, especially below; posteriorly it is detached. The iris and ciliary body are thickened.

No. 12.—The lower half of the eye of a man, aged 76, excised 10 days after the operation for extraction of cataract. Sup-

puration was noted as commencing on the fourth day. There is a well-marked arcus senilis. Yellow infiltration of the cornea extended down from the wound, but is not shown in the specimen. A yellow mass fills the anterior chamber. There is extensive purulent infiltration of the vitreous. The retina is thickened; the choroid slightly detached from the sclerotic, some gelatinous exudation lying between them. A small amount of soft lens matter has been left; this is also suppurating.

No. 13.—The two lateral halves of the right eye of a woman, aged 60, mounted in one cell. It was excised three weeks after the extraction of a cataract without iridectomy. Four days after she knocked it with her hand, and a week later pain, purulent infiltration of the cornea, and suppurative iritis set in.

The extraction wound is seen at the upper sclero-corneal margin, not very firmly healed, and with a knuckle of iris prolapsed into it. A thick, yellow, inflammatory membrane fills the pupil. A chip of hard, opaque lens-matter has been left at the upper part close to the wound. The vitreous is clear but somewhat shrunken; it is detached posteriorly. The retina is *in situ*. Some patches of uveal pigment have become detached from the surface of the choroid in mounting the specimen.

No. 14.—The two halves of a left eye, upon which the operation of extraction of cataract with iridectomy was performed in May, 1883. Good vision for a time was obtained, but it subsequently deteriorated. Needling was done in May, 1886, two needles being used; from that time up to excision, in July, 1891, it continued irritable. At the time of excision V. was = hand-movement only. Tn. The cornea was partly vascular, and no details of the fundus could be seen.

A fold of iris is seen to be entangled in the extraction cicatrix, so that it has not healed throughout its whole thickness. A fairly thick collar of lens matter has been left in the capsule in its entire circumference. Two thin rounded tags of capsule pass forwards through the anterior chamber, and are adherent to the cornea at the seat of the needle punctures. The angle of the anterior chamber is open on both sides of the section. The vitreous is shrunken and detached posteriorly. The retina is *in situ*.

No. 15.—The inner half of the right eye of a woman, aged 62, who, six weeks previous to its excision, had extraction of cataract performed with iridectomy; iritis rapidly followed, an hypopyon formed, and the tension became increased. At the time of excision it had no perception of light. At the upper sclero-corneal margin is a slightly puckered cicatrix, to which the lens capsule is adherent; the latter is thickened on its anterior surface by inflammatory deposit, and still contains some cortical matter in its periphery. The angle of the iris at the side of the coloboma is also adherent to the extraction cicatrix, and its pupillary border to the lens capsule. The angle of the anterior chamber is closed by the root of the iris on both sides of the section, it not having been removed quite up to its periphery above. The vitreous is shrunken and detached posteriorly; the retina is *in situ*. The optic papilla is slightly swollen.

No. 16.—The inner half of the right eye of a woman, aged 57, who, five months previous to its excision, had had extraction of cataract performed with iridectomy. Iritis commenced a week after. Three months later, punctate dots on the back of the cornea, iritis, and increased tension were noted in both eyes. The globe is elongated posteriorly and somewhat pyriform in shape. The extraction wound at the upper sclero-corneal margin has a broad plug of new formed tissue in it. The lens capsule is attached to it; some cortical lens matter remains in the periphery of the capsule. The iris above has been removed quite up to its periphery; below, its root is in contact with the posterior surface of the cornea, closing the angle of the anterior chamber. The vitreous, which has been partly removed from the specimen, was much shrunken and detached posteriorly. The retina was *in situ* when the eye was first opened. The optic disc is deeply cupped; there is an extensive area of choroidal atrophy around it. Microscopical examination shows accumulations of small round cells on the posterior surface of the cornea, and in the meshes of the ligamentum pectinatum, also nodules of round cells characteristic of "uveitis maligna" in the ciliary body and choroid.

No. 17.—The inner half of the left eye of a man, aged 39,

who had a cataract extracted from it with iridectomy one year and eight months previous to excision, and discission of the capsule a year later. The sight of it continued good up to within a month of its removal, when it failed, and the tension was found to be increased. The well-healed extraction cicatrix is seen at the upper sclero-corneal margin; the lens capsule is adherent to it, and also the iris at the margin of the coloboma.

FIG. 6.—Specimen 17, showing the lens capsule, which has a hole in its centre, adherent to the extraction cicatrix, and dragging forwards the iris in front of it.

There is a large hole in the centre of the capsule; hardly any lens matter has been left in it. The iris above has been removed nearly up to its root, but sufficient has probably been left to block the filtration area. The angle of the anterior chamber below was closed by the contact of the root of iris and cornea; it has now partially opened up. The retina is *in situ*; in mounting the specimen some of the uveal pigment has become detached from beneath it. There are two circular patches, about the equator, of choroidal atrophy and retinal pigmentation. The optic disc is cupped.

No. 18.—The anterior part of the lateral half of the left eye of a woman, aged 50. A year and ten months previous to its

removal, a cataract was extracted from it with iridectomy, and the patient obtained vision which enabled her to see to read and sew. This vision she retained up to within a month of the removal of the eye; then the sight, without any apparent cause, began to fail rapidly, and the tension was found to be increased. The extraction cicatrix, firmly healed, is well shown in the cornea a little distance from its upper margin. The lens capsule passes forwards through the coloboma, and is adherent to the cicatrix; a collar of cortical lens substance has been left within the capsule. The iris above has not been removed up to its extreme root, and what is left is held in contact with the posterior surface of the cornea by the entangled capsule. The periphery of the iris is also in contact with the cornea, blocking the angle of the anterior chamber in the rest of its circumference.

(Recorded in Trans. Ophth. Soc., vol. x, p. 115.)

No. 19.—The anterior part of the lateral half of the left eye of a man, aged 63. Three and a half months previous to its excision, a cataract was extracted from it with iridectomy; the anterior chamber was slow in re-forming, and subsequently the tension became increased. A sclerotomy, which was performed upwards, failed to relieve this, and the other eye developed sympathetic ophthalmitis. Two well-healed cicatrices are seen near the upper sclero-corneal margin: the more central, which is in a direction almost at right angles to the corneal surface, is that of the extraction wound; the more peripheral, that of the sclerotomy wound, is more oblique. The lens capsule, thickened with some inflammatory deposit, passes forwards through the coloboma, and is adherent to the cornea in the situation of the cicatrices. The angle of the anterior chamber below is not quite closed. Above, a small piece of the root of the iris has been left; it is held in contact with the posterior surface of the cornea by the entangled lens capsule. Microscopically an accumulation of round cells is seen about the root of the iris and the fibres of the ligamentum pectinatum.

(Recorded and figured in Trans. Ophth. Soc., vol. x, p. 129.)

No. 20.—The lateral half of the left eye of a woman, aged 64. A year previous to its excision, a cataract was extracted from it

with iridectomy, the operation being uncomplicated. Seven months later an attack of acute glaucoma came on and the sight rapidly failed. In the anterior chamber is a large cyst, which is seen microscopically to be lined by laminated epithelium; it has depressed the lower part of the iris downwards, and the lens capsule backwards. That portion of the iris which is not in contact with the cyst is pushed forwards into apposition with the posterior surface of the cornea. The extraction cicatrix can be seen at the upper sclero-corneal margin. The upper part of the iris has been removed, but not up to its extreme periphery. The retina is *in situ*.

(Recorded and figured in Trans. Ophth. Soc., vol. xii.)

No. 21.—A thick section of the front half of the left eye of a man, aged 65. A cataract, probably traumatic in origin, had been extracted from the eye eighteen months previous to excision: for six months it had been painful and inflamed. At the time of excision the tension was normal, but that it had been increased was rendered evident by the deep cupping and excavation of the optic nerve.

The extraction cicatrix is seen to be situated well in the substance of the cornea. The pupillary border of the iris above is adherent to it, also the anterior hyaloid of the vitreous, which is much displaced forwards. The angle of the anterior chamber on both sides of the section is closed by the apposition of the root of the iris to the posterior surface of the cornea.

(Recorded in Trans. Ophth. Soc., vol. x, p. 119.)

No. 22.—A thick section from the front half of the right eye of a woman, aged 64. Four and a half months previous to its excision, a cataract was extracted from it with iridectomy. Ten days after the operation she knocked the eye, and the wound reopened, after which the anterior chamber was slow in reforming. The tension at the time of excision was +2. There is some thickening about the extraction cicatrix; the root of the upper part of the iris has prolapsed and become healed in it. There is some inflammatory tissue in the coloboma, which unites the lens capsule to the cornea. The whole of the lower part of

the iris is drawn forwards and is in contact with the back of the cornea.

(Recorded and figured in Trans. Ophth. Soc., vol. x, p. 120.)

No. 23.—The two halves of the left eye, opened by an anterio-posterior vertical section, of a man with very rigid arteries, aged 62. A month previous to his coming under observation glaucomatous symptoms had commenced in it. The operation of iridectomy was performed, the vitreous presented, and the globe immediately became quite hard again. An attempt was then made to extract the lens, it, together with nearly the whole of the vitreous, became extruded, and the eye had to be excised. The freshly-made iridectomy incision is seen at the upper sclero-corneal margin. A portion of the upper part of the iris has been removed; part of its root now lies in the wound. The lens and vitreous are absent. The retina is detached from the choroid, and the choroid from the sclerotic, large blood clots lying between each of the tunics. In one half a portion of the retina has been cut away, in order to show the blood clots beneath it.

No. 24.—The two halves of an eye opened by an equatorial section. It had an iridectomy performed on it for glaucoma; this was followed by escape of vitreous and hæmorrhage. The choroid is detached from the sclerotic at every part of the equator by a thick, reddish-brown blood clot. This clot is $\frac{1}{4}$ inch thick in some parts, and extends backwards and forwards for a considerable distance from the equator. The cavity inclosed by the choroid is almost square on transverse section; the sides of this square correspond to the position of the recti muscles, its angles fitting into the inter-muscular spaces. The retina is also detached from the choroid, folded, and blood-stained. There is no vitreous chamber. The sub-retinal space does not now contain anything.

No. 25.—The two halves of an eye opened by an antero-posterior vertical section. It is the fellow eye to Specimen 24. It also had an iridectomy performed on it for glaucoma, which was followed by hæmorrhage and escape of lens and vitreous. An unhealed iridectomy wound is seen at the sclero-

corneal margin, with some blood-stained tissue prolapsing into it. The lens, vitreous, and a portion of the retina have escaped; a little of the retina is seen as shreds at the incision. The choroid is detached by a thick blood clot from the sclerotic: the detachment extends from the margin of the optic disc behind, as far as the attachment of the ciliary muscle and iris to the sclerotic in front. The detachment is deepest at the equator on the side opposite to the corneal incision.

No. 26.—The lateral half of the eye of a woman, aged 64, which was blind from acute glaucoma, and upon which sclerotomy was performed. Tension and pain returned after the operation, and the eye was excised three days later. The cornea is clear. The sclerotomy wound is seen almost at the extreme angle of the anterior chamber; it is considerably bulged, there being a large prolapse of iris into it. The pupil is semi-dilated, and irregularly drawn up. The root of the iris is adherent to the periphery of the cornea at the lower part. The lens is absent from the specimen, but was *in situ* when the eye was first opened.

(Recorded in R.L.O.H. Reports, vol. xiii, p. 180.)

No. 27.—The lower half of the eye of a woman, aged 40, who first came to the hospital for corneal ulcer and slight iritis in her right eye, for which atropine drops were ordered. A week later the tension was found to be +1, and the pupil widely dilated. A month after the commencement of these glaucomatous symptoms, to which eserine failed to give relief, an iridectomy was performed. The anterior chamber was slow in re-forming, and the tension ultimately returned. The eye was excised four months after her first attendance. The cornea, in the process of hardening the specimen, has become entirely opaque; in its recent state there was only a dense central opacity. On the inner surface of this opaque central portion the anterior capsule is adherent, the lens consequently being displaced forwards. The angle of the anterior chamber is narrow on both sides, from the apposition of the root of the iris to the cornea. The coloboma is not shown in the specimen, being entirely in the upper half of the globe. It was examined microscopically, and it was found that the iris

had been removed well up to its periphery. The filtration area had probably, however, been obstructed by the lens, which was drawn forwards. The retina is *in situ*. The vitreous is shrunken and detached.

(Recorded in R.L.O.H. Reports, vol. xiii, p. 197.)

No. 28.—The inner half of the left eye of a woman: two years previous to enucleation, the sight had failed suddenly, with great pain, and an iridectomy had been performed. There is a coloboma of the iris upwards, but a large portion of its root has been left. There is a cystoid condition of the cicatrix at the sclero-corneal margin, the whole of its inner surface being lined by atrophied iris tissue. The root of the iris is in contact with the periphery of the cornea in its entire circumference. The lens is cataractous, and has several scattered white striæ in it. The retina is completely detached, from the optic disc to the ora serrata, and much shrunken.

No. 29.—The inner half of the right eye of a man, aged 57, who, five years previous to its removal, had glaucoma in it, for which an iridectomy was performed. The tension returned, and the sight went completely. At the time of excision the tension of the eye was still more than normal. The line of the iridectomy incision is seen in the upper part of the cornea, firmly healed. The whole iris is extremely atrophied, and the pupil much dilated. There is only a narrow rim of iris, which is not adherent to the posterior surface of the cornea. The ciliary body is much atrophied, and a wide space is left between it and the margin of the lens. The choroid has extensive patches of atrophy in it, the sclerotic showing through. The vitreous is thin in consistency, and detached posteriorly. The optic disc shows deep cupping and excavation.

(Recorded in R.L.O.H. Reports, vol. xiii, p. 199.)

No. 30.—The lateral half of the left eye of a woman, aged 43, which, two and a half months previous to removal, had an iridectomy performed on it for glaucoma. A keratome was used, and the lens was wounded. The unhealed iridectomy wound is seen at the upper sclero-corneal margin. To this the lens is adherent. The upper part of the anterior capsule has evidently

been perforated; there is some yellow infiltration of the lens substance. The iris above has been removed nearly up to its extreme periphery; below, the angle of the anterior chamber is closed by the apposition of its root to the posterior surface of the cornea. The vitreous is of good consistency, and the retina *in situ*.

(Recorded in R.L.O.H. Reports, vol. xiii, p. 206.)

No. 31.—The inner half of the right eye of a woman, aged 41; three weeks previous to its removal, an iridectomy had been performed upon it for glaucoma. The same night the patient was very sick; the eye became very painful; its tension went up to +3, and the anterior chamber did not reform. Four days later an attempt was made to extract the lens with a scoop; only a portion of it was removed, and some vitreous escaped. The iridectomy cicatrix is seen at the upper sclero-corneal margin as a pigmented line, a portion of the root of the iris having become incarcerated in it. The lens, of which only about one-third has been removed, is tilted forwards at its upper border, and adherent to the cicatrix. The angle of the anterior chamber is closed in its entire circumference by the root of the iris; above, the iris has not been removed sufficiently up to its periphery to open it up. The vitreous is somewhat shrunken and detached posteriorly. The optic disc is very deeply cupped.

No. 32.—The lateral half of the right eye of a woman, aged 59. It had an iridectomy performed on it for glaucoma of three months' standing. The lens presented and was removed, this being soon followed by escape of vitreous and free hæmorrhage. It was excised the next day. The recent, gaping, iridectomy wound is shown at the lower sclero-corneal margin; a mass of blood-stained tissue protrudes through it. There are extensive blood clots between the choroid and sclerotic, also in the vitreous and anterior chambers. The optic disc is deeply cupped; the outlines of the cup show very distinctly, as it is filled with blood clots.

No. 33.—The lateral half of the right eye of a man, aged 64. It had had an iridectomy performed on it for glaucoma of seven months' duration. Two months after, at the time of the excision, the tension was again increased.

The iridectomy incision is seen well healed, not very peripheral, but free from any entanglement of iris. Macroscopically, the iris appears to have been removed right up to its extreme periphery. Microscopically, some portions of its anterior layers, intimately adherent to the posterior surface of the cornea, are seen still blocking the filtration area in the region of the coloboma. Elsewhere the angle of the anterior chamber is also closed, and the root of the iris much atrophied. The lens has become white and opaque, as the result of hardening. The vitreous is much shrunken and detached posteriorly. The retina is *in situ*. The choroid is much atrophied.

No. 34.—The lateral half of the eye of a man, aged 79, which had an iridectomy performed upon it for glaucoma. The operation was followed by hæmorrhage, and escape of the lens and vitreous. It was excised three days later.

At the upper sclero-corneal margin the recent, unhealed iridectomy wound is seen; some blood-stained tissue separates its two lips. There are extensive blood-clots between the choroid and sclerotic, which are widely separated below; the retina from the two sides is in contact. There are blood-clots in the anterior chamber. The lens and vitreous are absent.

No. 35.—The lateral half of an eye upon which, seven weeks previous to its removal, an iridectomy had been done preliminary to the removal of a cataract. Three years before, the eye had been injured by a piece of flint. At the time of excision there was iritis, no anterior chamber, T +2, and no p. l.

The section passes a little to one side of the coloboma, and includes the whole of it. There are several posterior synechiæ. The ciliary body is much swollen. The whole vitreous is full of pus and streaked with hæmorrhages. The retina is thickened and adherent to the vitreous, being partially detached from the choroid.

No. 36.—The posterior half of an eye of a young lady, who, 15 years previous to its removal, had it operated on for strabismus. She stated that sight had been lost in this eye since the procedure for cure of the squint, and that it had lately become irritable. Abscission was performed, and three weeks later,

when the wound had nearly healed, the opposite eye "became affected sympathetically." The stump, of which the specimen consists, was then excised. It is noted that there was a cicatrix over the internal rectus, where it was evident the coats of the eye had been wounded at the original operation. The retina is detached and shrunken, remaining attached at the entrance of the optic nerve. The uveal pigment is partly lost. On the inner surface of the choroid is a thick cup of bone. The cup is imperfect, being much smaller on the outer side than the inner, but everywhere surrounds the optic nerve.

No. 37.—The lateral half of the stump of an eye removed $2\frac{1}{2}$ years after the operation of abscission. The eye was wounded by a nail, and the same day abscission was done. For a few months previous to excision it had become painful. The sclera has been divided close to the corneal edge; the wound has closed in front, the edges being merely separated by a thin band of cicatricial tissue. On one side the ciliary muscle has to a great extent been left, while on the other it has been nearly entirely removed. In no part, however, has the section reached the ora serrata. There is some slight separation of the choroid from the sclerotic anteriorly. The retina is detached from the choroid, but remains adherent at the optic disc; some remnants of degenerated vitreous are contained between its folds.

No. 38.—The outer half of the right eye of a woman, aged 25, the sight of which was lost from inflammation in childhood. Fifteen years previous to its removal, the operation of tattooing was performed upon it. The globe is much elongated, and the cornea somewhat enlarged and staphylomatous; its centre has a quantity of black pigment in it, this has been inserted some depth in its substance. The iris is intimately adherent to the cornea over a large portion of its posterior surface. The lens is in its normal position, and there is a large posterior chamber. The vitreous is much shrunken. The retina, when the eye was first opened, was *in situ*, but has now some rucks in it.

ON THE DIAGNOSTIC VALUE OF THE LOSS OF THE PUPILLARY LIGHT-REACTION, WITH A NOTE ON THE OCULO-FACIAL MUSCULAR GROUP.

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The cases which are recorded in this paper have, for the most part, been observed in the out-patient department of the hospital, and my thanks are due to Mr. Marcus Gunn for allowing me to make use of them. The majority of the facts, with regard to the condition of the pupils, and of the optic nerves, have received independent verification at his hands.

As the amount of light which is thrown into the eye, and the method in which it is thrown, are important factors in determining the reaction of the pupil to light, the mode employed in the cases recorded may be briefly described. Firstly, the light ought not to be more intense than the eye is usually accustomed to, hence diffuse daylight is better than that thrown from a mirror; and secondly, all errors associated with accommodation and convergence must be carefully eliminated. The patient is requested to face the daylight coming through a window, one of the eyes being carefully covered by the observer's hand; while, with the other hand, the observer is readily able to alternately shut off the light and expose the eye for examination. In testing the consensual reflex it is important that the eye under observation should be partially protected, and not exposed to the full direct influence of light. The method of throwing light reflected from a mirror in a dark room, or of passing a lighted match in front of the eye, is regarded as fallacious, as it is impossible, in an untrained individual, to prevent a certain amount of accommodative contraction. It is not uncommon for very slight movements of the iris to occur, without any

alteration in the size of the pupil: these movements must be carefully distinguished from actual contraction and dilatation of the pupil itself.

The recorded cases have been divided for facility of description into series, but the important point to be determined from their study, lies in the relative diagnostic value which the several symptoms have upon the presence of degenerative changes in the central nervous system.

I. Cases exhibiting the Argyll-Robertson Pupil.

First Series.—Cases in which the Argyll-Robertson pupil occurred without loss of the knee-jerks.

Case 1.—Alice J., aged 26, married, has three healthy children, the eldest of whom is five years of age. She has had no miscarriages or still birth. There is no history of acute disease with the exception of small-pox when a child. There are no ataxic symptoms, but the knee-jerks are obtained only by means of the augmentation method (Jendrassik). R. V. = 6/9, Hm. 1·25 = 6/6, well. L. V. = 6/6, Hm. 0.

The pupils are equal in size, and measure, when looking at a distant object, 2 mm.; they are inactive to light, but react readily with convergence.

(This patient was only seen on one occasion.)

Case 2.—William P., aged 55, came to the hospital on account of double vision. There is paresis of the right external rectus muscle, slight drooping of the left upper eyelid and impairment of the upward movement of the left eyeball. The pupils are small, equal and quite inactive to light. Vision in both eyes = 6/6. The knee-jerks are normal. He states that on one occasion he has had "cramps" in the right leg. There is no disturbance of sensation, either subjective or objective. There has been no urinary trouble. There is a history of difficulty in walking some years previously, but this has entirely passed off.

(This patient was also seen by Dr. Ormerod, at Queen's Square Hospital.)

Case 3.—James M., aged 45, came to the hospital with catarrhal ophthalmia. His pupils were small, 2·5 mm., when looking at distant objects, and inactive to light, but contracted with convergence. His knee-jerks were present and equal; there was no ataxy, no lightning pains and no urinary trouble. He walked quite well along a straight line. He denied syphilis. R. V. = 6/6, Hm. 0·5 D. L. V. 6/6, Hm. 0·5 D.

(This patient was only seen on one occasion.)

Case 4.—M. L., aged 47, had suffered from occasional diplopia, but when he came to the hospital presented no evidence of paralysis of any of the external ocular muscles. Both pupils were inactive to light, but reacted on convergence. They were of equal size, and measured 2·5 mm. R. V. 6/18. L. V. 6/6. The optic discs were quite healthy.

The knee-jerks were only obtained by the augmentation test (Jendrassik). There was no ataxy, lightning pains, or urinary trouble.

This patient was seen again nine months after the original observations were made, and was found to present no alteration in or addition to these symptoms.

Case 5.—Joseph R., aged 45, presented a typical Argyll-Robertson pupil on the right side, the left was obscured by a large depressed corneal ulcer with hypopyon, the result of an injury a few weeks before he came to the hospital. Five months after this he returned. The right pupil was inactive to light, but acted well with accommodation; it measured 1·5 mm. The knee-jerks were present, but he presented no sign of ataxy, no leg pains, and no urinary trouble.

Case 6.—Clara L., aged 42, came to Moorfields with ptosis on the right side, nearly complete; she was unable to move the right globe upwards, inwards, or downwards; the movements resulting from the action of the external rectus and superior oblique muscles were unaffected. The left eye moved normally, both alone and in associated movements with the right. The right pupil measured 5 mm., and was inactive to light, both directly and consensuously, but contracted slightly on attempts at convergence. The left pupil measured 3·5 mm., and reacted

to light feebly, but contracted well with convergence. R. V. = 6/12; reads J. 1 type at 7 in. near point with +4 D. sph. L. V. = 6/6, Hm. +0·5 D.

There was a history of miscarriages shortly after marriage, but no *definite* specific history was obtained.

Both knee-jerks were present, and normal. This patient was treated with biniodide of mercury and blistering, and in six weeks the paralysis had entirely disappeared.

When last seen, four months after the original observation, the patient presented the following condition:—R. V. = 6/6, Hm. +0·5 D; J. 1 at 13½″; with +2·5 D. reads J. 1 at 7½″, near point. L. V. 6/6, Hm. +0·25 D.; J. 1 at 12″; +2·5 D. reads J. 1 at 7″ near point.

The pupils were of equal size, and contracted well with convergence. The right pupil was inactive directly, but contracted slightly when light was thrown into the other eye; the left eye reacted feebly to light. All other ocular movements were normal.

Case 7.—Arthur M., aged 29, complained of defective vision. R. V. 6/24, +1·5 D.= 6/9, L. V. 6/12, Hm. +1 D. The right pupil measured 5·5 mm., and was inactive to light and with convergence. The left pupil, 3·5 mm. was inactive to light, but reacted with convergence. There was slight drooping of the right upper lid and the right eye-ball did not rotate upwards as well as the left. The optic discs were healthy. The knee-jerks were normal. The sensibility to touch was defective over the infraorbital and inferior dental branches of the left fifth nerve, and there was an anæsthetic patch on the mucous membrane of the left lower lip. The patient had had syphilis, with well-marked secondary symptoms, ten years' ago.

He was seen six months later, but the symptoms presented little alteration; both pupils were, however, of equal size and inactive to light.

Case 8.—Jacob S., aged 32, said he saw double on looking to the right, R.V. 6/6, L.V. 6/6. HmO. The right pupil measured 2·5 mm. and was inactive to light; the left, 3 mm., only contracted very feebly. Both contracted with convergence. There was paresis of the right external rectus muscle. The patient

had suffered for some months from lightning pains in the legs. He said that he had want of confidence in himself when walking in the dark. He swayed when his feet were placed together. The knee-jerks, however, were readily obtained, but there was no ankle clonus. He had had syphilis seven years previously.

Six months later, both pupils presented the Argyll-Robertson phenomenon, and the knee-jerks were still active.

Second Series.—Cases exhibiting the Argyll-Robertson phenomenon on one side only.

(a.) Without other symptoms of nervous disease.

Case 9.—John R., aged 35, brought one of his children to Moorfields, suffering from interstitial keratitis. R. V. 6/6, Hm. 1·5 D; L. V. 6/6, Hm. 1·75 D. The right pupil, 4 mm. acted readily to light with convergence; the left pupil 2·5 mm., was inactive to light directly, but contracted to light through the other eye; it acted readily with convergence. The patient presented no symptoms of central nervous disease; there was no ataxy and the knee-jerks were equal and normal.

On inquiry he stated that his eldest child had been paralysed on the right side since it was 18 months old, the result of a series of convulsions; the second child was seen at the hospital with interstitial keratitis, while the third suffered from "thrush." Nineteen months after the original observation the patient presented the same symptoms, but he stated that he had suffered for some months from "sciatic" pains in the left leg.

Case 10.—Wm. W., aged 48, presented inequality of the pupils. The right pupil, 1·75 mm., was inactive to light directly and consensuously, but reacted with convergence. The left pupil, 3 mm., presented normal reactions. R. V. 6/9, Hm. +2 D, reads J. 1 type with +3·5 D; L. V. 6/12, Hm. +1 D, reads J. 1 type with +2·5 D. Both knee-jerks were present, but were only elicited by Jendrassik's augmentation method. There was no ataxy, no urinary trouble and no lightning pains. The patient denied syphilis.

The three following cases exhibit the Argyll-Robertson phenomenon on one side only, and they differ from the two preceding, inasmuch as they presented well-marked symptoms of central nervous disease. Although not uncommon, the association of reflex pupillary immobility with the symptoms of mixed sclerosis is sufficiently interesting to warrant their introduction here.

(b.) With symptoms of mixed sclerosis.

Case 11.—Samuel R., aged 54, was sent to me by Dr. Mowat, of Stamford Hill. The patient presented an ataxic gait, and there was great inco-ordination of the arm movements. He swayed very much when his feet were together and his eyes were shut. There was no history of lightning pains, but occasional delay in passing urine; he suffered much from pain in the lower part of the back. The knee-jerks were active, but an ankle clonus was not obtained. There was no apparent loss of sensation.

The right pupil, 3 mm., reacted readily to light and accommodation; the left pupil 2·5 mm., was inactive to light directly and consensuously, but contracted with accommodation. R. V. 6/18 c +1·5 D = 6/6, reads J. 1 type with +5 D at normal distance; L. V. 6/18 +1 D = 6/6, reads J. 1 type with +4 D sph. The fundus oculi was normal. The patient admitted having had syphilis twenty years ago. His face was marked with cicatrices. An important feature in this case was the fact, that the general symptoms markedly improved under a course of biniodide of mercury.

Case 12.—Harriet D., aged 40, came to the hospital complaining of headache and defective vision.

The right pupil, 4 mm., reacted to light and with convergence; the left pupil, 3·5 mm., was inactive to light directly and consensuously, but contracted with convergence. R. V. = 6/6. Hm. 0. L. V. 6/18. The fundus of both eyes was normal.

The patient complained much of pain in the fronto-parietal region on both sides, and there was some tenderness on percussion over the left temporo-parietal region. There was also occasional spasmodic closure of the left eyelids.

Tremors, characteristic of disseminated sclerosis, were observed on voluntary movement of both arms, but the gait was not spastic, and there was no alteration in the voice, and no nystagmus. Both knee-jerks were active.

No definite history could be obtained as to any cause for this patient's condition.

(*c.*) *In General Paralysis of the Insane.*

Case 13.—F. D., aged 41, presented the features of general paralysis: tremor of the facial muscles and tongue, and difficulty of articulation, associated with a state of mild dementia.

The right knee-jerk was active, the left of normal force. The right pupil, which was rather smaller than the left, reacted to light and with convergence. The left pupil was inactive to light directly or consensuously, but contracted with convergence. A history of recent "congestive attacks" affecting the right side of the body was obtained from the friends. The optic discs were hyperæmic, but not swollen.

Third Series.—Cases exhibiting the Argyll-Robertson pupil associated with atrophy of the optic nerve, but without loss of the knee-jerks.

Case 14.—Benjamin C., aged 61, came to the hospital complaining of failure of vision. The pupils were unequal, the right being considerably wider than the left. They were inactive to light, but reacted well with convergence.

R. V. = 6/36, L. V. = 6/12. Vision was not improved by glasses. Both optic discs were whitish and flat, and the vessels were considerably diminished in size, especially in the right eye. The knee-jerks were normal. The gait was natural, but the patient swayed slightly when his eyes were shut. There was no ataxy of the arms. Although the perception of colour generally was a little confused, there was no central colour scotoma, and there was no history of excessive tobacco-smoking.

Case 15.—Henry P., aged 66, when first examined in October, 1890, complained of dimness of vision.

R. V. Counts fingers when held before the eye.

L. V., 6/24; not improved by glasses. There was no paralysis of accommodation. Both pupils, 3 mm., were inactive to light, but contracted with convergence. There was primary optic atrophy in both eyes; considerably more marked in the right than in the left. The knee-jerks were readily obtained; but there was absolutely no evidence of any tabetic phenomena. The patient denied syphilis. He was under observation for many months, and the vision gradually became worse. When last seen (April, 1892) the vision in both eyes was mere light perception.

The knee-jerks were still present, and there were no tabetic symptoms.

In addition to the optic atrophy and reflex iridoplegia, this patient presented a partially cataractous condition of both lenses.

The three series of cases which have just been recorded present a common feature, viz., *reflex pupillary immobility* on one or both sides; while those in the third group exhibit, in addition, primary atrophy of the optic nerves.

The first question which arises in considering these cases is,—In how far do they indicate the actual presence, or the probable advent at a later date of progressive degenerative changes in the central nervous system?

In order to answer this, it is necessary to consider the cause of the loss of the pupillary light reflex. This may be due to structural alterations or degenerative changes in three situations:—

(1.) In the peripheral nervous apparatus or muscular structure of the iris; (2) in the afferent or efferent limbs of the reflex arc, *i.e.*, in the optic nerves, optic tracts, anterior roots of the third nerve, the ciliary ganglion, and the ciliary nerves; or (3) in the central mechanisms situated in and around the grey matter of the Sylvian aqueduct; *i.e.*, either in a group of small nerve-cells in the forepart of the oculomotor nucleus—the antero-lateral group of Darkschewitsch, or in the course of the system of fibres which unites the proximal end of the optic tracts and the oculomotor nuclei (Meynert's system of fibres).

(1.) It is well known that as old age comes on the

iris, from rigidity and sclerosis of its stroma, loses to some extent its contractile power, both when light is thrown on the retina, and with convergence; the pupil also becomes smaller, but it is doubtful whether the light reflex is ever entirely lost from this cause. Uhthoff (ref. in Ophth. Rev., vol. v, p. 104) has stated, from an examination of a large number of cases, that old age *alone* will not produce reflex pupillary immobility, although the contraction may only be very slight; the reflex is probably never absent in healthy, old people.

Immobility of the pupil in young people is rare, but may be due to structural peculiarities of the iris or nuclear degeneration, especially if loss of the light reflex is associated with loss of the convergence contraction, and the pupil is not dilated. This condition is illustrated in the case of a child, aged 13, whose right pupil was quite immobile, and measured 2·5 mm., the left being active to light, and with convergence. R. V. = 6/12; L. V. amblyopic. Hypermetropia estimated by the direct method at between 5 and 6 dioptres. This condition had been noticed three years previously, and noted on the out-patient letter. Both pupils dilated equally to 9 mm. under atropine; there was no evidence of inflammatory adhesions. Cases of this nature are rare, and the presence of reflex pupillary immobility ought to suggest interference with the reflex arc either in the peripheral nerves or centres.

It is therefore necessary to consider what evidence the cases afford of interference with—(2) the afferent or efferent limbs of the reflex arc; (3) the central mechanisms.

In order to simplify the consideration of this subject, a table of the principal features of the cases, apart from the reflex pupillary immobility, has been constructed:—

Case.	Palsy of oculo-motor nerves.	Optic nerve.	Knee-jerks.	Other facts.
1	None	Normal	Obtained only by augmentation	None.
2	Paresis of R. sixth Paresis of L. third	Normal	Normal	Hist. of ataxic gait and "cramps."
3	None	Normal	Normal	None.
4	Hist. of diplopia. No palsy observed	Normal	Obtained only by augmentation	None.
5	None	Normal	Normal	None.
6	Paralysis of R. third	Normal	Normal	None.
7	Paresis of R. third	Normal	Normal	Partial anæsthesia over distribution of L. fifth.
8	Paresis of R. sixth	Normal	Active	Leg pains, slight disturbance of equilibrium.
9	None	Normal	Normal	None.
10	None	Normal	Obtained only by augmentation	None.
11	None	Normal	Active	Marked disturbance of equilibrium.
12	None	Normal	Active	Tremors of diss. sclerosis.
13	None	Normal	Active	Tremors of general paralysis.
14	None	Atrophy	Normal	Slight swaying.
15	None	Atrophy	Normal	None.

(2.) A survey of the table shows that out of the 15 cases, 4 presented symptoms of palsy of an ocular motor nerve (2, 6, 7,8) : in 2 of these the *nervus abducens* was paralysed (2, 8), in one of which (2) the pupils were equal and there was no loss of accommodation, showing that the pupillary

and ciliary fibres of the third nerve had escaped. One case (4) gave a history of diplopia, no evidence of it being obtained when the patient was under examination. Of the 15 cases, then, only 2 (6, 7) showed implication of the efferent limb of the reflex arc at the time of observation, and 2 (14, 15) of the afferent limb; but, as is pointed out later on, the visual acuity of these two latter cases showed that the implication of the optic nerve was probably not the cause of the reflex immobility of the pupil. It is to Cases 6 and 7 that I wish to draw attention. When the patients first came under observation they presented the symptoms of more or less complete palsy of the right third nerve, with a feeble or abolished light reaction in the opposite pupil. After appropriate treatment, all evidence of the paralysis disappeared, but the pupils continued to present the Argyll-Robertson phenomenon. The diagnosis formed upon these facts was, that the pupillary condition was due to a central lesion and that the paralysis of the external ocular muscles was due either to a concomitant peripheral palsy, or was of the nature of the temporary palsies, probably of central origin, which are met with in tabes dorsalis.

(3.) I have endeavoured to show by a process of exclusion that the cause of the pupillary condition in these cases was not due to implication of the limbs of the reflex arc but to central changes; and reference to the table will throw further light on this subject. In 3 cases (11, 12, 13) there was no doubt as to the presence of degenerative changes in the central nervous system. In 3 (2, 8, 14) there was either the actual observation of, or a history of, difficulty in walking or slight disturbance of equilibrium. Case 2 described "cramps" in the legs, and Case 8 gave a history of lightning pains. In 3 cases (1, 4, 10), in which no evidence of central nervous disease was obtained other than the reflex pupillary immobility, the knee-jerks were only elicited by the augmentation method (Jendrassik). There are, therefore, left only 3

cases (3, 5, 9) in which no other symptom was associated with the fixed condition of the pupil to light. Two of these patients (3, 5) were only seen by me on one occasion three years ago, and their notes are scanty, so that it is not improbable that if they had been carefully looked for, some corroborative symptoms might have been detected. In Case 9, syphilis alone was probably the cause of the condition of the pupil. With the exception of Case 11, ataxy of the arms was not detected.

Uhthoff (*op. cit.*) has stated that 67·6 per cent. of the cases of reflex iridoplegia are due to tabes dorsalis; and Dr. Gowers' statistics are of value in this connection (Trans. Ophth. Soc., 1883), for he has shown that in cases of tabes in the first stage, *i.e.*, before there is difficulty in walking, 84 per cent. presented intraocular palsies, indicating that these affections are not only a common but an early symptom of this disease; and Minor (Neurol. Centralbl., 1892, p. 396) has pointed out that disappearance of the knee-jerk is by no means as early a symptom of tabes as some eye symptoms, *e.g.*, mydriasis, myosis, and the Argyll-Robertson pupil.

The majority of the cases which have been recorded here are to some extent confirmatory of these views, but a brief notice will be given to two other important causes of reflex pupillary immobility; these are general paralysis of the insane and syphilis. Uhthoff (*op. cit.*) has stated that the former is the cause of this condition in 85·5 per cent. of mental cases, while the latter is the cause in 8 per cent. of the cases in general and special hospitals. There was no evidence of general paralysis in the cases just narrated, with the notable exception of Case 13, while the possibility of syphilis as a causal factor, although no definite evidence of it was obtained in every case, ought not to be overlooked. As has been constantly pointed out, the absence of a history of syphilis in cases where the lesion is suggestive of this affection is of no value; witness Case 9 in this paper and numerous others in medical

literature and in practice. The fact, also, that a large number of cases of tabes are due to syphilis, shows that the disease may be indirectly the cause of the reflex pupillary immobility (Gowers).

The two cases, illustrative of the third series, exhibit the loss of the reflex contraction of the pupil to light in common with those of the first set, but in addition they present more or less interference with the function of the *afferent* limb of the reflex arc. That this latter condition was not the cause of the reflex pupillary immobility was apparent from the state of the visual acuity, which, in neither of the cases, except after many months in No. 15 was reduced to mere light-perception. It is more probable that the cause of both conditions was the same, viz., a degenerative lesion common to the optic nerves and tracts, and the central mechanisms ventral to the corpora quadrigemina, which subserve the reflex contraction of the pupil.

The presence of these two symptoms strongly suggests the diagnosis of tabes dorsalis, but, as reference to the cases shows, with the exception of slight swaying when the eyes were shut in No. 14, none of the classical phenomena of this disease were present. They raise, however, the very important question—How long may optic atrophy exist before loss of the knee-jerk ensues? Dr. Gowers has stated, on the other hand (Trans. Ophth. Soc., 1883) that, although atrophy may precede the other signs of tabes, it probably does not precede loss of the knee-jerk. From our present knowledge it is unnecessary to assume the existence of a concomitant sclerosis of the posterior root zone in the lumbar enlargement, or that the degeneration already present in higher parts should extend to the lower portions of the spinal cord to bring about this result; as we already know from the pathological observations of Pierret, Déjerine, Woodhead, E. Krause, and others, a very extensive peripheral series of changes may occur in this disease; and, among other alterations, degenerative

changes in the peripheral nerves of the lower extremities leading to loss of the knee-jerks.

The presence of these well-established peripheral changes has therefore suggested the possibility of an affection of the *nervus trigeminus* in those cases in which the sclerosis is apparently limited to the upper parts of the central nervous apparatus. Careful testing of the sensibility of the skin and mucous membranes supplied by this nerve in some of these cases, failed to show any evidence of an affection of the fifth nerve. But a reference to Case 7 will show, that in addition to the reflex pupillary immobility, there existed anæsthesia over certain portions of the distribution of the fifth cranial nerve.

And I have notes of a case* where, with primary optic atrophy, there existed defective sensibility over portions of the distribution of this nerve.

A. B., aged 53, complained of defective sight. The vision of both eyes was very defective, but more in the left than in the right (the actual state of the vision was not ascertained); both optic discs were atrophied. The knee-jerks were present, the right being slightly more active than the left. There was no history of lightning pains or gastric crises. There was no ataxy. There were no sensory disturbances on the legs, but the mucous membrane of the lower lip presented a small patch of anæsthesia, and the sensibility of the left side of the face was not quite so keen as the right.

The presence, then, of more or less anæsthesia over the distribution of the trigeminal nerve, in cases of reflex pupillary immobility, with or without primary optic atrophy, is suggestive of the presence of a sclerotic lesion, either in the trunk of the nerve or in the distribution of its roots, which form well-marked features in the topographical anatomy of the medulla oblongata and pons Varolii. I am inclined to think that the cause of this anæsthesia will be found in connection with the distribu-

* This case was seen in the out-patient department of the *Charité*, Berlin.

tion of the so-called "ascending root" of the fifth nerve, rather than in the trunk of nerve itself.*

The general conclusions to be derived from a study of these cases are (1) that the state of the pupil, known as the Argyll-Robertson phenomenon, existing by itself either on one or both sides, although not diagnostic, is highly suspicious of, the presence of an early progressive degenerative lesion in the upper portion of the central nervous apparatus; and (2) its presence ought to suggest the possibility of other symptoms, which may require careful investigation, such as the state of the knee-jerks, the condition of the optic nerves, the actual presence of, or (less valuable) the history of, paralysis of some of the external ocular muscles, and lastly, the presence of defective sensibility in the distribution of the *nervus trigeminus*.

The four cases illustrating reflex pupillary immobility on one side are of importance in localising the situation of the lesion which causes the phenomenon under consideration. As has been stated in Case 9, with abolition of the direct light reflex in one eye, there was retention of the consensual contraction; while in Cases 10, 11, 12, and 13 both the direct and the consensual reflexes were abolished. Laying aside at once an affection of the afferent or efferent limbs of the reflex arc as the cause in these cases, one concludes that the lesion is situated either in the centre for the sphincter iridis in the fore part of the oculomotor nucleus, or in the fibres which unite the nucleus with the proximal end of the optic tracts. In order to permit of consensual action, the afferent and efferent routes of opposite sides are commissurally connected; and this occurs in two ways, firstly, by the passage of fibres across the middle plane from

* Since this was written, I find that Westphal observed sclerosis in the ascending root of the fifth nerve (referred to by Gowers, Spinal Cord, p. 313), and Ross (Brain, 1887) regards the so-called ascending root of the fifth as analogous to the posterior root zone of the spinal nerves, in which area, as is well known, the lesion characteristic of tabes dorsalis is detected.

one nucleus to the other; and secondly, by fibres which pass dorsally to the aqueduct of Sylvius in the ventral portion of the posterior commissure, from the proximal end of the optic tract on one side to the oculomotor nucleus of the opposite side (Darkschéwitsch).

The lesion, then, which causes reflex pupillary immobility on one side, with retention of the consensual reflex, merely blocks the passage of the direct fibres from the optic tract to the oculomotor nucleus on the same side; while that which produces both direct and consensual immobility of the pupil on one side (assuming that there is only one lesion) occupies a position which blocks both the direct and the crossed system of fibres, *i.e.*, in the sphere of the centre of the sphincter iridis.

In endeavouring to localise the seat of the lesion in these cases, the size of the pupil, apart from its reaction to light, must be considered. Of 13 cases which exhibited the Argyll-Robertson pupil without implication of the optic nerves, 8 showed the phenomenon on both sides, and of these 6 were small pupils (*i.e.*, 2·5 to 3 mm. or under), while in the other 2 (Cases 7 and 8) the pupil on the side opposite to the oculomotor palsy was of medium size (3·5 to 4 mm.). Of the remaining cases, 5 showed the phenomenon on one side, and in 4 the affected pupil was smaller than the unaffected. It is usually stated in the text-books that the myosis is due to interference with the cilio-spinal fibres in the cervical region of the spinal cord, while the loss of the light reflex is occasioned by interference with Meynert's system of fibres, *i.e.*, those fibres which pass from the proximal end of the optic tracts to the oculomotor nuclei on the same side. This view, therefore, presupposes either a double lesion, or an extensive area of degeneration implicating structures so far apart as Meynert's fibres and the cilio-spinal region. In cases exhibiting evidence of sclerosis of the posterior columns such a diagnosis is admissible; but in the majority of the cases which are recorded in this paper, no evidence of such an affection was obtained. One

is, therefore, led to assume that a *single lesion* is the cause both of the myosis and of the reflex iridoplegia, and the only possible situation of this lesion is the Sylvian grey matter forming the forepart of the oculo-motor nucleus.

Accepting the view that dilatation of the pupil is due to inhibition of the sphincter iridis (an action comparable to others in the body), the lesion which causes interference with the passage of impressions along Meynert's fibres paralyses as well the sphincter inhibitory centre.

Dr. Gowers' observation that stimulation of the skin of the neck or palm of the hand does not cause reflex dilatation of the small Argyll-Robertson pupil is, I suggest, confirmatory of this view, and explains the contracted Argyll-Robertson pupil in those cases in which there is no evidence of sclerosis of the posterior column in the cervical region of the spinal cord, or implication of the sympathetic fibres.

These facts lend considerable support to the view that the centre subserving the reflex actions of the pupil consists of two parts, a sphincter-contracting and a sphincter-inhibitory centre, closely associated in function. The fibres from the former pass to the iris in company with fibres for the ciliary muscle by the third cranial nerve, while those from the latter pass down to and through the cervical portion of the spinal cord and enter the sympathetic through the lower cervical and upper dorsal nerve roots.

II.—Miscellaneous Cases.

Case 16.—*Ophthalmoplegia interna on one side, iridoplegia on the opposite side, associated with active knee-jerks.*

Wm. N., aged 28, had noticed that his pupils were of unequal size. R.V. 6/6, Hm +2 D; reads J. 1 type at 4 inches near point with +3 D. sph. L.V. 6/24 +2·5 D. =6/6. Reads J. 1 at 10″ near point only with +4·5 D. sph.

The right pupil, 3·5 mm., was inactive to light, and only contracted very slightly, if, indeed, at all, with convergence;

the left pupil, 5 mm., was inactive to light, and with convergence. The ocular movements were normal.

The optic discs were hyperæmic, but there was no evidence of any swelling.

There was no history of pains, or difficulty in walking. The knee-jerks were active. The patient contracted syphilis seven years ago.

Case 17.—*Ophthalmoplegia interna in the right eye; Argyll-Robertson pupil in the left; associated with double optic atrophy and loss of the knee-jerks.*

Edward W., aged 44, complained that his sight had been failing for some time. R.V. 6/36, not improved. Reads J. 19 type, but with +10 D. sph. reads J. 1 at 6–8." L.V. 6/18 +1·25 D. = 6/9. Reads J. 12 with +2·5 D. reads J. 1 easily.

The right pupil measures 6 mm., and is inactive to light, and with convergence; the left pupil, which is considerably less dilated, is inactive to light but contracts with convergence.

The ocular movements are good.

Both discs are white and atrophic, the right being much more advanced than the left. The right field of vision is contracted to 40° (temporal) and 20° (nasal side).

The knee-jerks are not obtained, but there is no ataxy. He walks well along a straight line.

He has had "rheumatic" pains in the legs, but no lightning pains. He had retention of urine for a short time, two or three years ago. He contracted syphilis fifteen years ago.

Case 18.—*Insufficiency of convergence; weakness of accommodation; loss of the pupillary convergence contraction, with retention of the light reflex.*

Miriam D., aged 38, had a severe attack of influenza four months before she came to Moorfields. There was no evidence of specific disease. R.V. 6/6 (partly), −0·75 D. sph. =6/6 (well). Reads J. 1 type at 10", n.p. with +2 D. sph. L.V. 6/6, −0·75 D. = 6/6 (well). Reads J. 1 type with +1·5 D. at 10" n.p.

There was insufficiency of convergence with both eyes,

amounting almost to complete paralysis. Conjugate deviation to the right or left, and upward or downward movements of the globe were normal.

The pupils, which were equal and medium, acted briskly to light, but there was very little or no contraction of the pupil on attempts at convergence.

CASE 19.—*Unilateral iridoplegia and cycloplegia.*

X. Y., aged 40, was seen with Dr. Walcot, of Camberley. This patient, who previously had good vision with the right eye, suddenly found that he was unable to see to write or read clearly.

R.V. = 5/9 (partly) +1·25 D. = 5/5 (clearly). Reads Snellen 2·25 D. at 20″; c +4 D. sph., reads 0·50 D. Snellen at 14″.

L.V. = 2/60 +3·5 D. = 5/60. This eye is amblyopic from an uncorrected error of refraction. The right pupil, which was larger than the left, was inactive to light and with convergence. The left, of medium size, reacted readily to light and with convergence. All external ocular movements and convergence were normal. The knee-jerks were readily obtained. There was no albumen in the urine and the arteries were in a healthy state. The optic discs and fundus oculi were healthy. There was a specific history.

Cases 16, 17, 18, and 19 are illustrative of the symptoms which follow disease of the whole or part of the fore-part of the oculomotor nucleus, which cell-group is regarded as innervating the internal ocular muscles. One of the most striking features of disease of this nucleus lies in the manner in which different subsidiary centres are picked out, and in the mode in which the nuclei are implicated on opposite sides. In Cases 16 and 17 on one side there is ophthalmoplegia interna, more or less complete, and on the opposite side merely abolition of the pupillary light reflex; in Case 18 entirely different centres are affected, viz., those subserving the contraction of the pupil with convergence and accommodation, while the centre for the pupillary light reflex is free; while in Case 19 the

centres subserving accommodation and the reflex action of the pupil are paralysed on one side only.

The study of the series of cases recorded in this paper suggests the following subdivision of the fore-part of the oculomotor nucleus :—

1. A sphincter-inhibitory centre, closely associated with a sphincter-contracting centre; which two subserve the pupillary light reflex.
2. A centre for accommodation.
3. A centre for contraction of the pupil with convergence, in close association with the centre for the associated action of the internal recti muscles.

I have brought forward no example of paralysis of accommodation existing by itself, but the condition is a well-recognised clinical entity and is an early feature in the post-diphtheritic palsies. The reaction of the pupil to light is not paralysed in this affection. In the recorded cases in which the centre for accommodation was paralysed as part of an ophthalmoplegia interna (Cases 16, 17, and 19) the pupillary contraction with convergence was in abeyance. The centre for accommodation, although probably not containing a centre for the contraction of the pupil, must be very closely related in function to the centre for contraction of the pupil with convergence.* The fact that convergence is associated with accommodation bears this out; and, as Case 18 illustrates, with paralysis of convergence there obtained palsy of accommodation and the associated action of the pupil.

Case 18 is of special value, as it shows an implication by disease of the centres for accommodation, contraction of the pupil with convergence and for the associated action of the internal recti muscles. As the centre for the pupillary light reflex was unaffected, a con-

* The view adopted here is that the contraction of the pupil is due to a certain degree of convergence taking place on accommodation.

dition the converse of the Argyll-Robertson phenomenon was obtained.*

III.—The Oculofacial Muscular Group.

It is a well-known fact that the true nervous supply of this or that muscular structure is not merely to be found in the anatomical distribution of a peripheral nerve, but in the nerve centres which control and regulate certain acts or movements. It is, therefore, a not uncommon thing to find in the human subject a peripheral nerve containing fibres which seem, as it were, to be included in it by chance, and which have their origin from a nucleus different to that from which the majority of the nerve fibres arise. The consideration of this subject has led to the formulation of the following hypothesis:—That the frontalis and orbicularis palpebrarum muscles, although peripherally supplied by the facial nerve, are "eye muscles," and form the oculofacial group, whose central innervation is the oculomotor nucleus (Mendel).

The facts which support this view may be fitly considered under three headings, the clinical, the experimental, and the anatomical.

The *clinical* evidence in favour of this hypothesis finds expression (*a*) in the well-known fact that in hemiplegia from cerebral causes the upper facial group of muscles retain their action, while the lower facial group are paralysed, suggesting, therefore, a separate innervation; (*b*) from a symptom observed in facial palsy, and to which attention was originally drawn by the distinguished describer of this affection (Sir Charles Bell), viz., that when the patient is told to shut the eyes, although the orbicularis muscle on the paralysed side remains inactive, the associated action of upward rotation of the eyeball goes on, suggestive of a close functional, and consequently a close anatomical relation between these two muscular actions; and (*c*)

* This case appears to closely resemble one recorded by Eales, Trans. Ophth. Soc., vol. iv., 1884, p. 300.

from the facts of chronic progressive atrophy of the bulbar nuclei (bulbar paralysis), which show a striking dissimilarity between the upper and lower facial muscular groups. In the ordinary form of this disease in an advanced stage, in addition to the paralysis of the tongue, soft palate, and vocal cords, there is paralysis of the lower facial and masticatory muscles, while those of the eyeballs, the frontalis and orbicularis palpebrarum muscles remain intact. But has the converse of this condition been observed, *i.e.*, has one seen in *total* nuclear ophthalmoplegia, paralysis of the frontalis and orbicularis palpebrarum with integrity of the facial and bulbar nuclei? I have not yet come across such a case in contemporary literature, but I have observed with Dr. Howard Tooth a case highly suggestive of this state of affairs, but which, I regret, I am unable to record.

The *experimental* evidence, so far as it goes, is confirmatory of this view. Mendel (Neurol. Centralbl., 1887, p. 537) performed experiments after Gudden's method on rabbits and guinea-pigs. From six to ten months after he had stitched the eyelids together, and detached the frontalis and orbicularis muscles from the bone on one side, he killed the animals. Careful examination of the abducens and seventh nerve nuclei failed to show any change in them. Changes, however, consisting in great diminution in the number of the ganglion cells and atrophy of their protoplasm, were found in the hinder part of the oculomotor nucleus. He suggested that the paths of communication between the oculomotor nuclei and the facial nerve was by the posterior longitudinal bundle.

But the *anatomical* data seem to lend the greatest corroborative support to this hypothesis; and the facts which are here recorded are an epitome of those from a case of bulbar paralysis which was fully reported by Dr. Tooth and myself in *Brain*, Part lvi, p. 473. The clinical features presented by this case were those already mentioned, viz., more or less complete paralysis of all the

muscles supplied from centres below the motor nucleus of the fifth cranial nerve, with the exception of the abducens; while the muscles of the eyeballs, the frontales, and the orbiculares palpebrarum were quite intact. The anatomical conditions which supported these facts were complete immunity from disease of the oculomotor, and abducens nuclei, while those of the fifth (motor division), seventh, and twelfth cranial nerves presented an atrophied state, and the conclusion to which we came was, that there passed in the trunk of the portio dura, nerve fibres which had no connection with the cells of the seventh nucleus, to supply the unaffected muscles of the face, viz., the oculofacial group.

Since the publication of that paper, I have collected several facts which bear more or less directly on this point.

Bœttiger (Arch. für Psych., xxi, ii) found in a case of nuclear ophthalmoplegia that the dorsal segment of the oculomotor nucleus was perfectly healthy, and suggested that this might be a possible source of innervation for the oculofacial muscular group.

Siemerling (Arch. für Psych., Bd. xxii, Suppl.), from a study of several cases of ophthalmoplegia, suggested that a small group of cells which lie among the fibres of the posterior longitudinal bundles, between the nuclei of the third and fourth nerves, and which he had found to give origin to the fibres which supply the *musculus levator palpebræ*, might have some relation to the *orbicularis palpebrarum.*

Müller (referred to by Bœttiger, *op. cit.*) described a case of blocking of the upper part of the basilar artery, from which there resulted paralysis of the eye muscles and of the oculofacial group.

Spitzka (Philadelph. Neurol. Soc., 1885) from anatomical studies came to the conclusion than an aberrant fasciculus from the oculomotor nucleus passed by way of the posterior longitudinal bundle to the *genu facialis;*

while the delimitation by Hitzig of a special centre in the dog's cortex for the eye and eye-face muscles ought not to be overlooked.

The view that the oculofacial group of muscles is innervated from the oculomotor nucleus, originally advanced by Mendel from experimental facts alone, therefore, receives corroboration both from clinical and anatomical data.

ON A CASE OF SUBHYALOID RETINAL HÆMORRHAGES.

By W. T. Holmes Spicer,
Clinical Assistant to the Hospital.

A CONSIDERABLE number of cases of large, circular, subhyaloid hæmorrhages at the central region of the fundus has been described in the Transactions of the Ophthalmological Society and elsewhere, and a few cases have appeared of similar hæmorrhages in other parts of the fundus,—but the simultaneous appearance of two colossal circular hæmorrhages, one covering the yellow spot region, and one in the upper part of the fundus, together with a hæmorrhage ensheathing a large retinal vein, gives sufficient interest to the following case to justify its insertion in these Reports. In addition, the singular phenomenon of the occurrence of a fresh effusion of blood on the surface of the old one, distinct from it, and yet not diffused into the vitreous, is noteworthy.

Edwin J., aged 33, a farrier, came under the care of Mr. Gunn at Moorfields on December 17th, 1890. The sight of both eyes was quite good till the morning of December 14th, when he noticed, shortly after rising, a dimness creeping over the right eye; the dimness increased during the morning, but has not changed since.

Now he cannot see in the upper part of his field with the right eye. When he looks at a gaslight, he is only conscious of a red blur; by looking over it he can see the light indistinctly.

He has enjoyed good health lately, and has had no cough nor vomiting; he is subject to constipation, but has not been troubled with it for some time; he had not been in any way straining himself when the failure of sight began. He was subject to bleeding at the nose some months ago, but has been free from it lately. He is rather dyspeptic, has attacks of acidity and heartburn, and his urine has a thick deposit after

standing. He constantly has pains about his limbs, and catches cold very easily, but this he attributes to his work, which causes him to perspire very freely, and at the same time exposes him to draughts. He smokes and drinks in moderation.

He does not know much about his family; his father died when he was a child, and he does not know of any gouty traditions.

He is a well-nourished man, of flabby aspect, and slightly dusky complexion; an examination of the heart showed the apex beat to be in the normal position, there was no murmur; the pulsation of the veins of the neck was marked. The pulse was not notably hard. Urine 1010 acid, no albumen.

L. V. 6/6 Hm. 0·5 D. R. V. Counts fingers in the lower part of the field, but can see nothing above a horizontal line. The external appearance of both eyes is normal.

Ophthalmoscopically, the fundus of the left eye appears healthy. In the right eye there is a very large semi-circular hæmorrhage concealing the yellow spot region, more than filling the whole field of the pupil; its upper limit is a sharply defined horizontal line, on a level with the upper part of the optic disc, but there are stains of blood above, as if the hæmorrhage had been at one time circular. All the vessels which cross the area of the hæmorrhage disappear entirely; the much distended, lower temporal vein disappears beneath the hæmorrhage and reappears beyond it, and in the line of the course of this vein the surface of the hæmorrhage is broken by a white patch, appearing like a window in it, through which what appears to be the vein can be seen. There is another very large circular hæmorrhage, having similar characters, over the upper branch of the superior temporal vein. The surfaces of both masses of blood are quite smooth and uniform, and from their margins there is a bright sheeny reflection, very white and glistening from the upper one. There has been some extravasation of blood beyond the circular limit of the mass of both hæmorrhages.

Around the inferior nasal vein there is a complete sheath of blood for some distance along its course, in part concealing it, and in the centre of the hæmorrhage there is a white shining mass, appearing like an inflammatory effusion from the vein itself. All the veins are dark-coloured, distended, baggy, and

slightly varicose; their light-streak is irregular. The arteries appear normal, and do not constrict the veins as they cross them. Refraction of fundus emmetropic; refraction of surface of hæmorrhage is H 2 D.

December 18th.—The white spot on the central hæmorrhage over the course of the inferior temporal vein has changed to a deep crimson colour; the upper level of the hæmorrhage is no longer horizontal, but has become irregularly convex in shape.

The first drawing was made on this day.

December 24th.—Both hæmorrhages are less dense in colour, and are undergoing changes, shown by cholesterin crystals on their surfaces; the shining reflex from their margins has almost disappeared. At the point of apparent entrance of the inferior temporal vein into the large central hæmorrhage, and extending over the seat of surface-disturbance already mentioned, there is a fresh effusion of blood lying on the surface of the old one—this is either a fresh hæmorrhage, or a rupture of the limiting membrane of the old one, allowing of a partial escape of its contents, but it is remarkable that the blood is still confined within the limits of the hyaloid, and is not diffused; the vitreous is quite clear.

January 14th, 1891.—The upper limit of the central hæmorrhage varies a great deal from time to time; it is sometimes quite horizontal and straight, sometimes convex; this variation seems to depend upon what the patient's position has been for the previous hour or two; it shows that the blood is still in part fluid. Both of the original hæmorrhages are contracting in area, the level of the blood being much lower in the central one, while the upper one keeps its circular shape. The retinal vessels as they pass under the upper part of the central hæmorrhage from which the blood has settled, gradually disappear in the overlying haze. The fresh effusion of blood on the surface of the original central one has extended its limits; it still lies in front of the first one, but it also reaches beyond it for some distance to its inner side. Its upper surface is horizontal; its shape is that of an irregular sector of a circle. The blood around the nasal vein has been absorbed. V. 6/24.

The second drawing was made at this time.

February 11th.—Everything before the affected eye became suddenly smoky last week, but is clearer now. The vitreous is

crowded with opacities varying from fine dust to large shreds of considerable size; the central hæmorrhage has apparently ruptured, as no trace of it is seen through the haze.

March 11th.—The vitreous has cleared up almost entirely. No defects can be made out in the vessel walls; there is no sign of the central hæmorrhage left; the upper one has contracted, but is otherwise unchanged. The vision in both eyes is now 6/6.

October 15th, 1892.—The patient was seen again to-day; he looked and felt remarkably well, and has had no further trouble. An examination of the right eye showed that the yellow spot hæmorrhage had entirely disappeared, and had left no trace behind in the form of white patches, or of folds in the hyaloid; the upper circular hæmorrhage had also disappeared, the only sign of the previous disturbance being a very fine surface pigmentation extending for a short distance along both sides of the superior temporal vein. The veins were less distended than when he was last seen. V. 6/6 in both eyes.

To sum up—a man, in apparent good health, suddenly and without pain loses the sight of one eye, to such an extent that he can only see a bright light as a red blur. As a cause of this, there are found two large, circular, retinal hæmorrhages, one of which entirely covers the yellow spot region, together with marked venous congestion of the retina. After a period of gradual absorption there is a fresh effusion on the surface of one of the old ones, assuming the form of a sector of a circle, as shown in the second drawing. Next, the whole of this bursts into the vitreous and becomes diffused; the final condition is complete recovery of vision, and entire clearing of the vitreous from all trace of blood.

It is now generally admitted, that the seat of these hæmorrhages of large dimensions and drop-like form is between the internal limiting membrane of the retina and the hyaloid membrane of the vitreous, and their point of origin is allowed to be one of the retinal vessels. It was formerly supposed that they were choroidal, or that they were between the layers of the retina; the picture in Liebreich's Atlas shows the retinal vessel passing over the upper part of a large central hæmorrhage, in which the

coloured part of the blood has sunk to the bottom. Apart from the improbability of such an amount of blood detaching the retina or tearing it up without leaving any trace, and without affecting vision, the blood vessels in several of the cases have been seen passing, as they do in this case, behind and not in front of the decolorised portion of the hæmorrhage. In most of the cases, too, the patient has been conscious of something before the eye obstructing vision, a positive scotoma, generally a red blur, a proof of the presence of the obstructing body in front of the rods and cones. The form of the hæmorrhage, that of a greater or smaller portion of a circle, is owing to the blood exuding on the surface of the retina, and meeting with an equal resistance from the hyaloid in every direction, and detaching it equally all round; the blood is in the form of a flattened drop; this shape explains the smooth abrupt edge and the different colour and brightness of the surface, according to the part of the curve reflecting the light. Hæmorrhages of a circular form do sometimes occur in the deeper layers of the retina, but they have not the perfectly regular circular shape and well defined edge of the subhyaloid hæmorrhage; they are flattened, and their surface has the same refraction as the rest of the retina; if they occur at the yellow spot they cause a more lasting impairment of vision. Choroidal hæmorrhages may sometimes be seen of a more or less circular form, but less regular than the ones in question, and distinctly flattened out; traces of retinal vessels or retinal striation can be seen in front of them, and they generally leave behind atrophic patches or irregularity of the choroidal pigment.

The simultaneous occurrence of large hæmorrhages beneath the hyaloid membrane, and of other small ones confined within the limits of the retina, is a probable sign of the identity of the two forms, the large circular hæmorrhage only differing from the flame-shaped or ensheathing ones in the amount of blood effused: the greater mass of fluid in the former is sufficient to make a way through the

membrana limitans interna, and exude as a flattened drop on to its surface.

A marked feature in the subhyaloid hæmorrhages is their tendency to occur at the yellow spot more than at other parts of the fundus. Mr. Gunn has stated, but not I believe published, his opinion that the hyaloid membrane, although definitely attached to the internal limiting membrane of the retina generally, has only the slenderest possible connection with it at the yellow spot, so that a potential space exists between the two membranes into which any effused fluid would find its way. By his kindness I have been enabled to examine the sections of the retina at the yellow spot on which he formed his opinion. From an examination of these carefully prepared specimens, one is driven to conclude that it is almost impossible to obtain a section of this region with the hyaloid in its proper place. As soon as the section approaches the yellow spot, the hyaloid is found to be entirely detached, although keeping its place in other parts of the fundus; there does not seem to be any definite place or distance from the fovea at which the hyaloid loses its firmness of adhesion, it is certainly not attached more firmly immediately around the yellow spot than elsewhere. There is probably a weakening of the attachment, beginning at some distance from the macula, and gradually increasing as this point is reached. This is the part of the fundus most free from vessels of any magnitude, and it may be that the hyaloid is more firmly adherent where the large vessels of the retina run.

Whatever be the cause of it, a hæmorrhage anywhere in this region, though not actually at the yellow spot, would find its way into and fill this potential space; also there is less support given to the vessels here than elsewhere by the loosely attached hyaloid, and this may be a factor in the determination of which is the vessel to give way, where all are equally distended.

A marked feature in the case of E. J. was the venous

nature of the affection; all the retinal veins were full, dark-coloured, of uneven calibre, in some places constricted, in others distended, the constriction occurring elsewhere than where an artery crossed them, and not therefore due to high tension in the arterial system. Both large hæmorrhages occurred over the course of one of the distended veins, and there was another hæmorrhage completely ensheathing one of the nasal veins. In the centre of this last hæmorrhage, immediately surrounding the vein, there was a white woolly patch of effusion, a limited periphlebitis; there was also a somewhat similar patch surrounding the inferior temporal vein where it lay beneath the large central hæmorrhage, the effusion being sufficient to show itself on the surface of this mass of blood.

In most of the cases of large, spontaneous, retinal hæmorrhage that have been published, no mention has been made of the condition of the blood vessels, and of the possible venous or arterial origin of the blood. Yet in a considerable proportion of these cases some evidence can be obtained, either from the description of the case or from the ophthalmoscopic drawing, of the venous source of the blood, or of some disturbance of the retinal venous system. In Mr. Hutchinson's first case, in Vol. I of the Ophth. Soc. Trans., the veins were thrombosed, and surrounded by a white mist; in Mr. Spencer Watson's case in the same volume, in addition to the large hæmorrhage, there was another flame-shaped hæmorrhage along a retinal vein. In Mr. Jessop's case, in Vol. VI of the Ophth. Soc. Trans., there is a vein running through the large hæmorrhage, and, after emerging from it, again hidden by another small hæmorrhage; after these hæmorrhages cleared up some small, white, flocculent spots were left clustered along the course of the vein. In Mr. Silcock's case in Vol. VII, a very tortuous vein is figured and described as losing itself in the hæmorrhage; in Mr. Lang's case in Vol. VIII no figure is given, and no mention is made of

the retinal veins except that, after the hæmorrhage had begun to clear up, the hyaloid membrane could be seen radiating in streaks from a branch of the upper temporal vein, as if it had been attached to the vein at that point. In all other cases no mention is made of the kind of vessel affected, and it is not possible to make out from the drawings.

From a consideration of their manner of occurrence, and of the conditions of the intraocular circulation and tension, one would be led to suspect a venous origin to all large hæmorrhages of this kind. The effusion is sudden and large,—that is to say, it has its source in a vessel of some size, an artery or vein, and not in a capillary. The flow of blood goes on rapidly up to a certain point, and then ceases spontaneously; the cause of this cessation is either a raising of the pressure outside the blood vessel to the level of that within it, or an exhaustion of the source of supply. The raising of the pressure might be brought about by fluid tension within the immediate cavity into which the blood is being poured, the subhyaloid space, or by the raising of the intraocular tension by the addition to the fluid contents of the eye. In the case of the subhyaloid space, if a source of fluid pressure able to cause a separation of the hyaloid membrane still persisted, it would be able to detach that membrane still further, the adhesive force of the membrane not being markedly increased. As to raising of the intraocular tension, pain is not a sensation which usually accompanies intraocular hæmorrhages of this type; no mention is made of it by the patient, and there is, as a rule, no sense of discomfort or fulness within the eye; that is to say, the amount of the hæmorrhage is not enough to distend the eyeball to the extent of causing functional disturbance of most delicate organs, or of producing palpable hardness of the globe.

For these reasons it is probable that the source of the blood is venous and not arterial, and that it is not a fresh importation of fluid, but already exists stored up in the

vessels of the eye. An active pressure of blood like that maintained in an artery, in the absence of syncope, would cause the blood to be continually poured out till pressure outside it equalled the pressure within; but the flow from a distended weak-walled vein would relieve the venous congestion, and exhaust for a time the source of the flow.

The case from the arterial side was put forward very strongly by Mr. Hutchinson and others in the early volumes of the Transactions of the Ophthalmological Society, and general arterial tension was invoked as a cause of the yielding of the arterial wall. But the existence of increased arterial tension being denied by the highest authority on the subject, then the opposite conditions of low tension, and finally of unequal tension, were adduced as explaining the hæmorrhage. Further observation is needed: in the meantime it is certain that a very large number, if not the greater number of retinal hæmorrhages have their origin in the veins of that structure.

Next, as to the affinity of these cases; they belong to a very large class in which spontaneous hæmorrhages tend to occur in various parts of the body—retinal hæmorrhages without signs of renal disease, vitreous hæmorrhage, subconjunctival ecchymoses, bleedings into the orbit or from the nose, and probably elsewhere in less evident places. Their causation has been fully discussed by Mr. Hutchinson, who finds in them all a certain gouty tendency; the appearance and life history of E. J. would fully justify his being placed in this class.

EXPLANATION OF PLATE.

Fig. 1.—Large circular subhyaloid hæmorrhages, one concealing the yellow spot region, another in the upper part of the fundus. A small retinal hæmorrhage is seen ensheathing the inferior nasal vein.

Fig. 2.—The yellow spot hæmorrhage is shown to have a fresh effusion of blood, also subhyaloid, on its surface down and in.

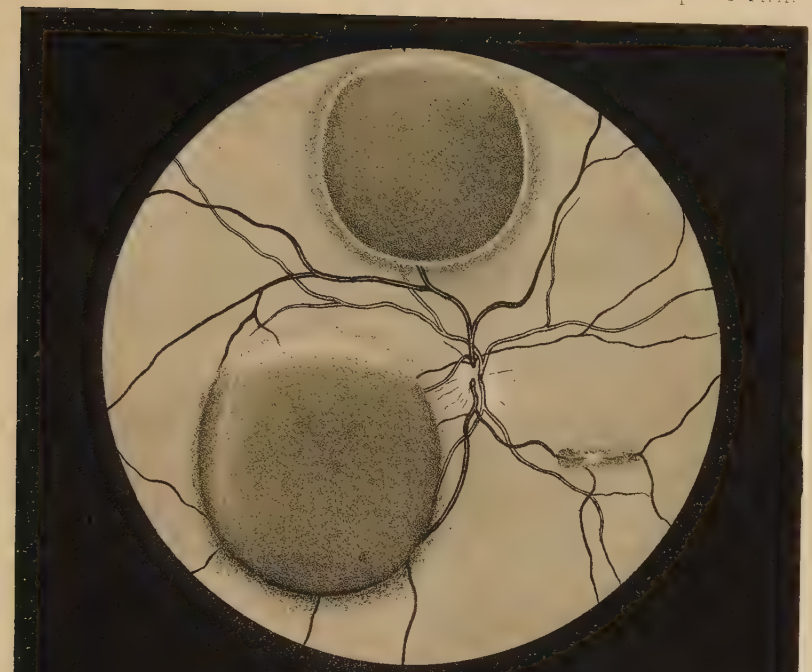


Fig. 1.

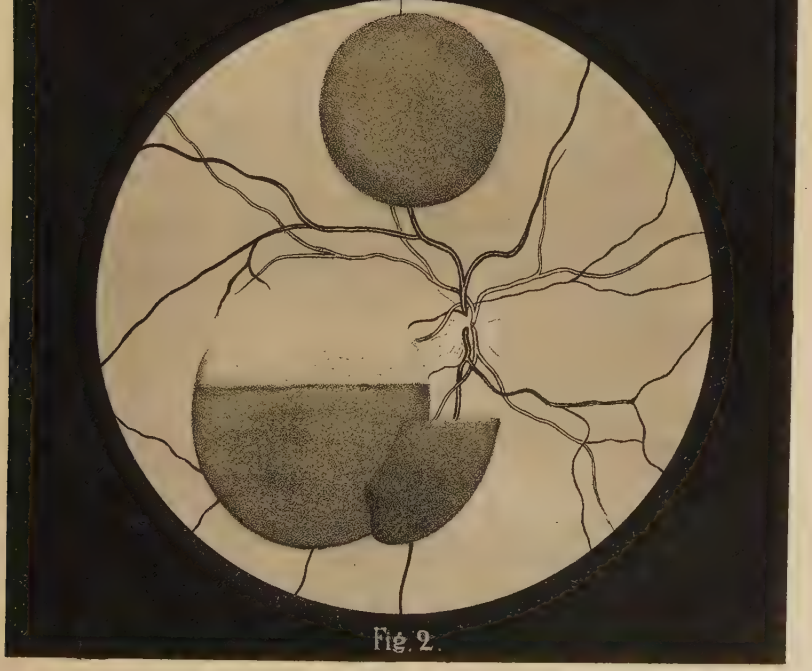


Fig. 2.

Holmes Spicer, del.

Danielsson & Co, lith.

PSEUDO-GLIOMA.

By E. Treacher Collins.

Curator of the Museum.

That the diagnosis of glioma of the retina is still often attended with considerable difficulty is shown by the fact, that, during the four years from July, 1888, to July, 1892, of the 1,020 eyes which were excised at the Moorfields Hospital, 24 were removed because they were supposed to contain a glioma of the retina, and in 7 of these the pathological examination subsequently showed this not to be the case.

These cases, in which the appearances in the eye simulate closely those of a true glioma of the retina, are termed pseudo-glioma, a term which, in that it implies no definite pathological condition, is a bad one, but is of considerable use clinically, because it includes three distinct conditions of the eye, which, with our present knowledge, are not only very difficult to differentiate from true glioma, but still more difficult to distinguish from one another. Defining pseudo-glioma, then, as any condition of the eye liable to be mistaken for true glioma, the term may be applied to three classes of cases—

1st. Those in which there is a persistence and thickening of the posterior part of the fœtal fibro-vascular sheath of the lens, or an atypical development of the anterior part of the vitreous, with or without a persistent hyaloid artery.

2nd. Cases in which large masses of tubercle occur in the choroid.

3rd. Cases in which there has been inflammatory effusion into the vitreous, following a retinitis and cyclitis, and in most cases accompanied by detachment of the retina.

(1.) *Congenital Defects at the back of the Lens.*

Of the first class of cases I have recorded in full two examples in Part I of the present volume of these Reports, pp. 92—96. In each of these there was a mass of elongated cells at the back of the lens, into which the hyaloid artery, which was persistent and patent, passed forwards and broke up. This mass of cells was either the posterior part of the fibro-vascular sheath of the lens, which, instead of disappearing, had, on account of the persistence of the hyaloid artery, become much thickened; or an irregular development of the anterior part of the vitreous. Situated behind the lens, it gave rise to a white reflex, and, having blood-vessels coursing through it, was naturally taken for a glioma of the retina. To these two cases I now add the following:—

Case 1.—*Persistence and thickening of the posterior fibro-vascular sheath of the lens. Hæmorrhage into the lens. Diagnosis of glioma retinæ.*

Maud H., aged 9 months, was brought to the Moorfields Hospital, as an out-patient, on August 26, 1891. Her parents had noticed some difference between her two eyes when she was three weeks old, and lately their attention had been called to a peculiar appearance in her left eye, by a neighbour.

The pupils of the two eyes were equal; nothing abnormal was detected in the right. A grey reflex was seen in the left, which, after dilatation of the pupil with atropine, appeared to be a soft-looking mass in the vitreous, close behind the lens, having a large hæmorrhage on its surface. A red reflex could be obtained around this opacity, through the margins of the lens, in all directions. The tension of the eye was normal. Glioma of the retina was diagnosed, and the eye excised on August 29.

Pathological Examination.—The measurements of the globe are antero-posterior 19 mm., lateral 18 mm., vertical 18 mm. The cornea is clear, the iris and anterior chamber normal. The lens is more globular than usual, measuring 6·5 mm. laterally,

4·5 mm. antero-posteriorly; at its posterior pole is an opacity with a reddish stain on its surface in the outer part. The vitreous is detached from the retina posteriorly; no remains of its central artery can be seen. The retina is a little folded at the ora serrata, and has one or two other slight creases in it. There is no new growth in connection with it.

Microscopical Appearances.—Sections that pass through the pupil show, in the lens, considerable spacing out of its fibres, and some breaking down of them into irregular hyaline masses and hyaline globules; it is doubtful how much of this change is the result of the hardening reagents.

The anterior capsule appears healthy; it is lined in the normal way by a single layer of cells which terminate in their usual position in the nucleated zone of the lens. On tracing the capsule backwards from the nucleated zone, it is seen as a normal capsule, unlined by cells, for a short distance, then on both sides of the section a number of nucleated fibres appear on

FIG. 1.—Showing the microscopical appearances of the lens in Case 1. There is a mass of nucleated fibres at the posterior pole; here the capsule (*c*) is deficient. In the lens substance in front of the nucleated fibres are several hæmorrhages (*h*). The lens fibres are much disorganised.

its inner surface, and further back some fibres of a similar nature on its outer surface also.

At the posterior pole of the lens the hyaline structure of the capsule is quite lost, there being only a mass of fibres and nuclei. Some sections taken outside the pupil show a similar condition of lens capsule to that at the posterior pole; in those, however, taken furthest out, the hyaline capsule is continuous, with nucleated fibres on each side of it. In these sections through the outer part of the lens, there are collections of red blood corpuscles between the lens fibres at the posterior pole. These corpuscles have stained a rusty brown colour with eosine, less pink than usual. No blood vessels can be seen in their vicinity, either in the lens or amongst the fibres behind it.

The most likely explanation of the appearances seen in this eye seems to be that there was some defect in the development of the posterior capsule of the lens, and that the hyaloid artery was late in disappearing, which led to a persistence and thickening of the posterior fibro-vascular sheath. The hæmorrhage in the lens, which appears old, can only have come from a branch of the hyaloid artery previous to its disappearance. Hæmorrhages into the lens must necessarily be of extremely rare occurrence.

Alt* says, "Hæmorrhagic cataract has been once examined and described by von Graefe. He found the lens fibres brown, which colour was caused by granular and crystallised blood-pigment within them, while their shape was unaltered. The capsular epithelial cells, too, were filled with the pigment. It could not be ascertained, in this case, whether the lens-capsule was intact or ruptured."

The next case is of particular interest, because its true nature, viz., persistence of the hyaloid artery and of the posterior fibro-vascular sheath of the lens, was diagnosed when it was first seen. Subsequent changes in the eye, however, seemed rather in favour of glioma, and it was removed. It serves to illustrate points to which attention should be directed, in order to distinguish between these two affections.

* Lectures on the Human Eye, p. 194.

CASE 2.—*Persistence and thickening of the posterior fibro-vascular sheath of the lens. Persistence of the central artery of the vitreous. Lens itself, at first clear, becoming opaque.*

William M., aged 4 weeks, was brought as an out-patient to the Moorfields Hospital on March 31, 1892. The mother stated that she first noticed a white appearance in his right eye, three weeks after his birth. On examination a greyish-white opacity, with a somewhat metallic lustre, was seen behind the lens; in its centre was a small, dark, round, slightly depressed spot with fine blood vessels coursing through it. The lens itself was quite clear, and a red reflex could be obtained round the extreme margin of the opacity in all directions. This last point, together with the colour of the opacity and the central dark spot in it, all seemed in favour of the case being one of a persistent hyaloid artery and posterior fibro-vascular sheath, rather than a glioma of the retina. No operation was therefore recommended.

At the end of July the patient was again brought to the hospital, and the mother said the white spot in the right eye seemed to be getting larger, and that for about the last month she had noticed "a dull speck right inside his left eye." A careful examination was then made under chloroform. In the right eye the anterior chamber was very shallow, more so than when first seen. The whole lens had become of a milky-white colour, so that the points before seen at its posterior part were not now visible. The tension was normal. In the left eye the lens was quite clear, and nothing abnormal could be detected in the fundus.

The symptoms now exhibited in the right eye seemed to indicate something of a progressive nature. The probabilities of the case being one of glioma were thought to be such as to make it advisable that the eye should be removed. It was accordingly excised on August 4, 1892.

Pathological Examination.—The eye-ball was opened in the fresh state. The lens, which is milky-white throughout, easily separates from its capsule. Behind the posterior capsule is a dense white membrane. Passing right through the centre of the vitreous from the optic disc to this white membrane, is a thin, grey band; it expands slightly where it joins the optic disc.

The vitreous is of good consistency, and the retina is in position. In the centre of the inner half of the globe, a little distance from the ora serrata, is a white patch, having the appearance of atrophy of the choroid with disturbance of pigment around it. There are also two small white spots at the ora serrata, in the centre of the outer half.

Microscopical Examination.—The white membrane behind the lens capsule is seen to be composed of a dense mass of fibres and cells; there are a few small blood vessels in it containing red blood corpuscles. All the ciliary processes are adherent to this membrane, being directed towards the posterior surface of the lens and not to its sides. There are thin prolongations forwards from the dense membrane at the back of the capsule, round its sides, and over its anterior surface. In front of the anterior capsule it consists only of a thin layer of scattered fibres and cells. Epithelial cells line the inner surface of the posterior capsule as well as the anterior.

In the patch described as situated in the centre of the inner half of the globe, the retina is seen to be much altered and adherent to the uveal pigment layer, the cells of which have undergone considerable proliferation. The rods and cones cease at the border of the patch, as also does the outer granular layer. The inner granular and nerve fibre layers are thickened and irregular; there are some small extravasations of red blood corpuscles in the latter. The choroid beneath this patch shows no inflammatory changes; there is a slight depression in its elastic lamina, otherwise it appears normal.

(2.) *Tubercle of the Choroid.*

The difficulty in diagnosis which sometimes occurs between cases of tubercle of the choroid and glioma of the retina was pointed out by Dr. Brailey,* and more recently by Jung,† who records one case of tubercle diagnosed as glioma, and one of glioma diagnosed as tubercle. The following are the details of an eye that I have examined, very similar in several respects to the first of Jung's cases,

* Trans. Ophth. Soc., vol. iii, p. 129.

† V. Graefe's Archiv, xxxvii, iv, p. 125.

as in it the optic nerve was invaded by tubercular growth.

CASE 3.—*Tubercle of choroid invading optic nerve. Detachment of retina. Case diagnosed as glioma retinæ.*

Robert Y., aged 2, was admitted to the Moorfields Hospital on May 3, 1889. His right eye was said to have been bad about ten weeks. There was general injection, total posterior synechiæ, a small hyphæma, and a yellowish reflex from behind the lens. The tension was increased. The eye was thought to contain a gliomatous tumour of the retina, and was excised the next day.

Pathological Examination.—The eyeball is much enlarged; antero-posteriorly it measures 22 mm., laterally 20 mm., and vertically 20 mm. There is considerable bulging of the posterior part of the sclerotic, which is of a grey colour. The optic nerve immediately behind the globe is enlarged; it measures 5 mm. across; the section of it has an unusually greyish soft appearance. A second portion of the nerve has been removed; the distal (ocular) end of this measures 5 mm., and the proximal (cerebral) end 3 mm. The lens is misshapen, being rounder than normal; antero-posteriorly it measures 6 mm., laterally 8 mm. The whole of the posterior half of the globe is filled with a greyish-yellow flocculent mass. No pigment layer separates it from the sclerotic, which latter is thickened. In front of the greyish-yellow mass is seen the detached and crumpled retina, only separated from the back of the lens by the remains of the shrunken and fibrous vitreous. There is some separation of the ciliary body from the sclerotic anteriorly.

Microscopical Appearances.—Covering the front of the iris and stretching across the pupil is a newly formed layer of fibrous tissue. The iris and ciliary body are much infiltrated with small round cells. There is an extensive hæmorrhage between the ciliary muscle and sclerotic. The layers of the detached retina are much disorganised; it is infiltrated with round cells, as is also the shrunken vitreous between it and the lens. Behind the detached retina, completely replacing the choroid, and involving the sclerotic, is a mass composed of numerous conglomerated nodules, having the typical histological appear-

ance of tubercle; in parts, giant cell systems, the nuclei in the giant cells being arranged peripherally; in others, various sized areas undergoing caseation.

The optic nerve is throughout much infiltrated with round cells; these are densest in the trabeculæ of fibrous tissue between the nerve fibres. In the central portions of the nerve the changes are more extensive than in the peripheral. Here several giant cells with peripherally arranged nuclei are seen; there are also patches of caseous degeneration in it. (See Plate.)

(3.) *Inflammatory Exudation into the Vitreous, with or without Detachment of Retina.*

The third variety of cases which may be included under the heading pseudo-glioma are far more frequently met with than the other two. Mr. Nettleship, in 1882, read a paper before the Ophthalmological Society, entitled "On certain cases of Destructive Ophthalmitis, simulating Glioma, in Children," in which he gave the most important points of such published cases as he was able to find, and discussed the subject very fully. In bringing forward a fresh series of 11 cases, in all of which the eyes have been examined pathologically, I hope, besides emphasising the facts he has pointed out, to add a few new ones, which may help to elucidate this somewhat obscure affection.

As is well known, in these cases the eye symptoms are frequently preceded by some acute febrile condition, in many cases by head symptoms of greater or less severity; of my 11 cases, head symptoms are noted in 6.

Mr. Nettleship says:—"The convulsions, screaming, and unconsciousness, of which a history is often obtained, might point to some form of meningitis of which the ocular disease was an occasional consequence. I must confess that in a certain number of the cases, where the history of cerebral disturbance has been clear, this explanation has seemed to me at the time very probable. It is supported by the well known fact that purulent irido-

choroiditis occurs in some cases of epidemic cerebro-spinal meningitis. Professor Förster, in his valuable chapter in Graefe and Saemisch's handbook on the relation between ophthalmic and general diseases, states positively that sporadic meningitis, especially in children under 5, is a common cause of the eye changes we are considering; he does not, however, give any details." He goes on to ask the following questions:—"Should meningitis be proved, we shall still have to ask why and how it does sometimes cause inflammation of the uveal tract instead of optic neuritis; how is the mischief set up, and why is it so much more common in children than adults?"

In Case 13, recorded near the end of this paper, the eye was excised in an early stage of the disease, and the patient ultimately died; the *post-mortem* showed extensive inflammation of the meninges at the base of the brain, which was probably started by middle ear disease. Mr. Nettleship, in Trans. Ophth. Soc., vol. v, has recorded a case, in some points very similar to the above. It was one in which purulent irido-cyclitis with opaque vitreous occurred in a young child suffering from a febrile disease. Death occurred in six weeks, and cerebro-spinal meningitis and purulent disease of the middle ear were found.

These two cases seem to prove that the inflammatory changes in the eyes of children which simulate glioma retinæ are sometimes preceded by meningitis, and they render it highly probable that in all the cases in which cerebral symptoms are obtained some inflammation of the meninges has occurred.

The connection between the intra-ocular inflammation and the meningitis might be embolic, or one of direct extension along the optic nerve. Through the kindness of Dr. Arkle, I was able to obtain the optic nerves and commissure of Case 13 for microscopical examination. The appearances which they present are suggestive, though not conclusive, of direct extension. There was marked papillitis and inflammation of the ocular end of the nerve,

also of the optic commissure, the cerebral end of the optic nerve and the membranes around them, as far as about the apex of the orbit. The stump of the optic nerve, however, left in the orbit, exhibited but slight hypernucleation; possibly the inflammation in it had somewhat subsided since the removal of the eye.

In most of the other cases there was papillitis or inflammatory change in the ocular part of the nerve. Sufficient of the latter, however, had not been removed to exclude the possibility of an extension of the inflammation back from the eye.

The occurrence of middle ear disease in the two cases above mentioned is of particular interest. In Case 13, no complaint was made of the ear, and it was not until the patient had been a week under observation, and some inspissated material was removed by syringing, that an abscess was discovered in the left tympanum. In Mr. Nettleship's case, the ear disease was not recognised during life, but the middle ear and the mastoid cells were found to contain a good deal of thick pus at the *post-mortem* examination. Neither in this case nor in Case 13 was there any bone disease, and the lateral sinuses in both of them appeared healthy. No microscopical examination of the auditory nerves was made, to see if there was any extension of inflammation along or around them.

That the meningitis was secondary to the purulent disease of the middle ear is an easy and probable explanation of its occurrence, and it suggests a new point for enquiry in these cases. That the enquiry should not be merely restricted to the statements of the mother of the patient is shown by the two cases here referred to. It should include an examination of the ears themselves. In the other cases, included in this paper, this point has only been partially gone into, as many of them had passed from observation before its importance was recognised. In 4 of the 11 cases some ear affection is noted.

In my anatomical examination of the eyes, I have endeavoured to determine the order in which the structures became involved, and the course of the disease. As the specimens are usually obtained only when the disease is far advanced, this is not easy. I have, however, been fortunate in obtaining one in which only four days (Case 13) and another in which two weeks (Case 14) had elapsed between the onset of the inflammatory symptoms and the excision of the eye. My specimens seem to show that the following is the sequence of events:—

The affection begins as an inflammation of the retina (Case 13), the exudation from the vessels of which passes into the vitreous, the hyaloid membrane of the latter becoming adherent to its inner surface (Cases 5, 6, 8, 11, 12, 13, and 14). The pars ciliaris retinæ is usually soon involved, its elements undergoing extensive proliferation (Cases 8, 12, 13, and 14). Later, inflammation extends to the stroma of the ciliary body and iris, nodules of round cells forming in them (Cases 6, 7, 12, and 14). Occasionally neither the iris nor ciliary body becomes at all affected (Cases 5, 10, and 11). The choroid more often escapes than the anterior portions of the uveal tract (Cases 9, 10, and 13); when it is implicated, that part bordering on the optic nerve is most often inflamed (Cases 6, 8, 11, and 14). There is nearly always marked proliferation of the epithelial pigment cells on its inner surface. Some of them grow into the substance of the retina (Cases 5, 8, 9, and 10); patches of them may remain adherent to its outer surface when it has become detached (Cases 6 and 12). These proliferated epithelial pigment cells subsequently seem to give rise to hyaline structures (Cases 5, 9, 10, and 11), or to undergo fatty degeneration, crystals of cholesterine forming amongst them (Cases 6 and 11).

The pigment epithelium of the ciliary body occasionally grows inwards in the form of long tubular processes (Cases 8 and 9). Some of the inflammatory exudation

which has collected in the vitreous may pass forwards between the ciliary processes, iris, and lens, and, being of a very plastic character, cause adhesion of these structures to one another (Cases 6, 8, 12, 13, and 14). Later, fibrous tissue and blood vessels develop in this inflammatory exudation; the former contracts, and in so doing draws the retina away from the choroid (Cases 4, 6, 7, 8, 9, 10, 11, 12, and 14). Should it be adherent to the root of the iris it will retract it, deepening the angle of the anterior chamber at its periphery (Cases 4, 6, 8, 12, and 14). Sometimes the root of the iris gets pressed forwards into contact with the cornea, probably as a result of increase of pressure in the vitreous chamber from plastic exudation into it (Cases 10, and 12). When the vitreous has become adherent to the lens capsule, and fibrous tissue develops in it and contracts, the latter becomes puckered, a considerable projection forming at the posterior pole of the lens (Fig. 2. Cases 8 and 14). A contracting band of fibrous tissue behind the lens tends also to push it forwards, shallowing the anterior chamber in the centre (Cases 4, 6, 7, 9, 11, 12, and 14).

In conclusion, I will summarise the points to which attention should be directed for the purpose of distinguishing these cases from one another, as well as from glioma. In some, as will be drawn from what has already been stated, it is impossible to be certain as to their nature; in others, a diagnosis can only be arrived at from the balance of evidence offered by several small points, not from one symptom alone.

The Appearance of the Opacity.—In glioma of the retina the appearance of the opacity behind the lens varies considerably, according to the relation of the growth to the retina; when it springs from its outer surface, growing between it and the choroid (glioma exophytum), the growth is viewed clinically through the retina, and a mass with a smooth surface is seen, having enlarged retinal vessels on it, close behind the lens. If, however, it springs

from the inner surface of the retina, growing forwards into the vitreous (glioma endophytum), then, on looking into the eye, the ragged surface of the growth itself is seen far back, often with little secondary floating nodules in front of it, and no retinal blood vessels on its surface.

The reflex obtained from a persistent and thickened posterior fibro-vascular sheath is usually greyer than that from a glioma, and this grey opacity may be confined to the central portions of the posterior part of the lens, a red reflex being seen through it at its extreme periphery in all directions. When the central hyaloid artery is persistent and patent, some of its branches, smaller than retinal vessels, may be seen coursing through the grey membrane, and occasionally, as in Case 2, there will be a central spot in it, suggestive of the termination of the central hyaloid artery.

An inflammatory membrane behind the lens may have new blood vessels developed in it, but these are smaller than retinal blood vessels.

There is nothing, so far as I know, distinctive about the appearance of the opacity, seen in a case of tubercle of the choroid which simulates glioma.

Condition of the Anterior Chamber.—In glioma the lens is often pushed forwards, and the anterior chamber uniformly shallow.

Should it be deepened at its periphery and shallow in the centre, the case may be diagnosed as one in which there has been inflammatory exudation into the vitreous and circumlental space which, in organisation and contraction, has drawn back the root of the iris, and pushed the lens forwards. I believe, then, glioma may be absolutely excluded.

The anterior chamber in cases of persistence of the posterior fibro-vascular sheath is sometimes very shallow.

Condition of the Iris.—Posterior synechiæ are common in cases beginning as retinitis with exudation into the

vitreous, and may be met with in connection with tubercle of the choroid. Their occurrence does not exclude the possibility of a case being one of glioma, for occasionally, though rarely, it is associated with an inflammation of the uveal tract.

The presence of a remnant of the pupillary membrane, would be suggestive that the other appearances seen in the eye were due to some congenital abnormality.

Tension of the Eye.—The tension in infants' eyes is often very difficult to determine; in older children it is a point of importance. In 57 eyes with glioma of the retina, to the notes of which I have been able to refer,* the tension was estimated immediately after excision. In 33 of these it was increased, in 1 doubtfully increased, in 19 normal, in 2 minus, and in 2 the eye was shrunken. Of the two which had minus tension, one was staphylomatous, with an extra-ocular growth posteriorly, and in the other the accuracy of the record is, I think, not very reliable. There is as yet no definite proof that in the early stage of glioma of the retina, as in the early stage of sarcoma of the choroid, the tension is minus. Dr. Brailey,† writing on this point, says: "I have been able to draw no evidence in support of this my first point (— T. and intra-ocular tumour) from retinal glioma, perhaps because in this disease the friends of the patient rarely suspect anything wrong previous to the establishment of the tension."

As the second eye of a patient is often, on ophthalmoscopic examination, found to be involved, when he has been brought for glioma of the other, the question of the tension in the early stage of the disease ought to be easily settled.

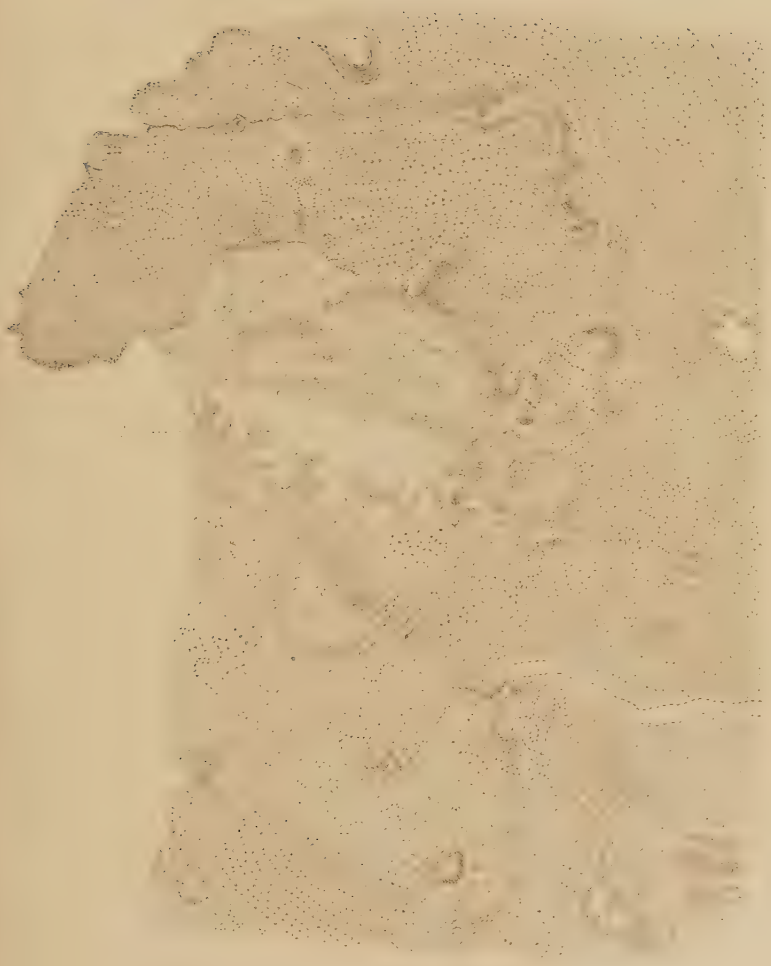
In glioma of the retina there would not be the same

* Most of these are cases the other particulars of which are given in the tables published by Mr. Lawford and myself in vol. xiii, pp. 20 to 36; the others are eyes which have been removed at Moorfields Hospital since these tables appeared.

† R.L.O.H. Reports, vol. x. p. 276.

EXPLANATION OF PLATE.

This Plate shows a portion of a Section of the Optic Nerve in a case of Tubercle of the Choroid (Case 3). The letters *g*, *g*, point to giant cells, and the letter *c* to a patch of caseous degeneration.



H. Lew

Dunidson & Co sculp

tendency to early pressure on the posterior ciliary arteries that there is in sarcoma of the choroid, arresting the blood supply to part of the ciliary body, and so cutting off the nutrient fluid of the vitreous, causing it to shrink.

If, as has been asserted, eyes with glioma of the retina occasionally shrink, these would probably at one time have minus tension. The evidence which has been brought forward on this matter was discussed by Mr. Lawford and myself in the present volume of these Reports. Case 15 recorded in this paper is one in which the left eye contained an evident glioma, and the right, the first to be affected, was shrunken. Both were excised, and the shrunken one, as well as the other, was found full of gliomatous growth (Fig. 3). The cornea of the shrunken one had been perforated, and the lens was absent. It could not, however, be definitely determined whether the new growth in it commenced before the eye shrank or afterwards.

In cases of pseudo-glioma, with detached retina and exudation into the vitreous, the tension is frequently minus; it may, however, be increased (Cases 10, 12, and 13).

History of the Case.—The history of fits, unconsciousness, attacks of screaming, ear disease, one of the acute specific fevers, or of symptoms of syphilis preceding the eye affection, would be in favour of the case being one of ophthalmitis. If the opacity was noticed at or soon after birth, the case would probably be either glioma, which is occasionally congenital, or a persistent fibro-vascular sheath. Should the symptoms have been produced by a tubercular mass, there might be evidence of lesions of a similar nature in other parts of the body.

Case 4 (*Register No.* 886).—*Fibrous tissue formation in vitreous. Detachment of retina. Retraction of root of iris. History of a fit.*

William F., aged 15 months, was admitted to the Moorfields Hospital on July 11, 1882. His mother stated that she first

noticed a white mark in his left eye six weeks previously. The child had been ill for a fortnight, during which time he had a fit which lasted a quarter of an hour.

She had one other child, aged 3, and had no miscarriages.

In the patient's left eye the iris appeared atrophied; the pupillary margin was close to the cornea, and the ciliary margin was retracted. There were some posterior synechiæ and a white glistening reflex from behind the lens. The tension was minus. The right eye was apparently healthy. The left eye was excised the same day.

Pathological Examination.—There is an umbrella-shaped detachment of the retina; between it and the lens is a dense mass apparently composed of fibrous tissue. The outer part of the iris is drawn backwards so as to make the periphery of the anterior chamber very deep, while the centre is very shallow, owing to the approach of the lens to the cornea. No microscopical examination was made.

Case 5 (*Register No.* 959).—*Detachment and inflammation of retina. Shrunken vitreous. No history of illness previous to eye affection. Subsequent history of deafness.*

Sidney F., a healthy looking boy, aged 5, was admitted to the Moorfields Hospital on November 4, 1882. His mother stated that three weeks ago she noticed what she described as "a scum" in the patient's right eye. On covering his left eye it was found he could not see with his right. On examination, the anterior chamber of his right eye was seen to be of good depth. The pupil was dilated, and behind the lens was a white appearance simulating that of a glioma. The periphery of the iris was not retracted. The eye was excised the same day. In reply to an enquiry with regard to her son's health, made in November, 1891, the mother wrote, "That he was not at all strong, and that he suffers very much at times from deafness."

Pathological Examination.—There is umbrella-shaped detachment of retina; it is much folded and puckered. The vitreous is much shrunken. A colourless fluid, full of cholesterine crystals, escaped from between the retina and choroid on opening the eye. A small, rounded, firm nodule projects from the inner surface of the choroid a little to one side of the optic disc.

Microscopical Appearances.—No inflammatory changes are seen in either the iris or ciliary body. There is slight but not marked increase of cells in the shrunken vitreous. The retina shows extensive changes; its blood vessels appear large and around them there is considerable cell exudation; there are some small hæmorrhages in it. The retinal layers are much disturbed, with thickening and spacing out of its structure in places, and increase of its fibrous tissue elements; no rods and cones can be recognised. There are scattered cells in it containing pigment, chiefly in the outer portions. The choroid is congested; there is œdema of the supra-choroidal lymph space. The uveal pigment layer in places is very deficient in pigment; in others, the cells are several layers thick. The rounded mass a little to one side of the optic disc is composed of layers of a hyaline structure, in places regularly laminated, in others very irregularly arranged, and having flattened cells between them; some of these contain pigment. The tissue, where it is regularly laminated, resembles very much the structure of the cornea. The uveal pigment layer ceases, and is folded back upon itself, where this mass commences. The elastic lamina cannot be traced beneath the mass, but seems to fuse with it. There is some round-celled exudation in the vascular layers of the choroid around it. The optic nerve shows considerable increase in the number of staining nuclei between its bundles of fibres, also between its pial and dural sheaths; this increase extends for some little distance behind the lamina cribrosa, but, on approaching the cut end of the nerve, it is less marked.

Case 6 (*Register No.* 1763).—*Fibrous tissue formation in vitreous. Detachment of retina. Head symptoms soon after removal of eye, and frequent headaches since.*

Frederick A., aged 9, was admitted to the Moorfields Hospital on April 7, 1885. His right eye was said to be inflamed and painful about Christmas; it remained bad for about a week; there had been no inflammation in it since. The colour of the eye was said to have changed during the last month; occasionally he had pain in the eyeball and around it. Three years ago he had "inflammation of the lungs," and was very ill. The child himself gave an indefinite history of a blow on the

eye from a stone about Christmas-time. On examination, his left eye appeared healthy, V. = 6/6. His right was slightly shrunken, the iris was discoloured, the pupil inactive to light except consensuously. There was a white reflex from the fundus, and the tension was slightly minus. On the supposition that it contained a new growth, the eye was excised the following day. He was subsequently seen on February 24, 1892. He then stated that after leaving the Hospital he was laid up in bed for a fortnight with "headache and lightheadedness;" that he has never been strong since, and frequently suffers from dull headaches. He has never had any discharge from the ears. There were no signs of past neuritis in the left eye.

Pathological Examination.—The anterior chamber is shallow in the centre, and deeper in the periphery, due to pushing forwards of the lens and retraction of the root of the iris. The iris is adherent to the lens capsule at the upper part. There is umbrella-shaped detachment of retina. The vitreous is shrunken, and has what appears to be inflammatory effusion into it immediately behind the lens. On the outer surface of the detached retina, chiefly in the upper half, are several small, granular-looking, rounded projections, and close to the optic disc are some similar-looking growths. There is a large quantity of firm subretinal effusion. The choroid appears normal.

Microscopical Appearances.—The posterior of the two uveal pigment layers on the back of the iris is at the pupillary border separated from the anterior, and adherent to the lens capsule. There is some increase in the number of round cells in the tissue of the iris in this region. There is more marked increase in the ciliary body between the muscle and the uveal pigment. The choroid is thin; there is increase of cells in it at the margin of the optic disc, but not much elsewhere. The lens shows some changes in the neighbourhood of its nucleated zone on one side; instead of flattened nucleated fibres there are large globular nucleated cells, and the cells lining the capsule extend round farther than usual. Adherent to the root of the iris on one side, and filling the circumlental space, is a dense mass of fibrous tissue, with scattered nuclei, patches of brown pigment, and blood vessels in it; similar tissue exists between the posterior surface of the lens and the detached retina, ad-

herent to both. The retina is much puckered, and all its tissue is spaced out; here and there rods and cones can be seen. Adherent to its outer surface are masses with numerous slit-like spaces in them, which appear to have had crystals of cholesterine dissolved out from them. In parts these masses are composed of nucleated cells of an epithelial type, with fine granules of brown pigment in them; they are like uveal pigment cells, but less densely pigmented. In other parts these masses are composed of fat globules, scattered pigment granules, and a homogeneous substance. The optic nerve, immediately behind the lamina cribrosa, is much infiltrated with round cells; there is also some accumulation of them between its pial and dura-sheaths.

Case 7 (*Register No.* 1943).—*Detachment and thickening of retina. No history of illness previous to eye affection.*

Bessie R., aged 16 months, was admitted to the Moorfields Hospital on October 23, 1885. Her mother stated that patient's left eye had always looked "strange and small." When she was about 7 months old the colour of it changed, and it moved up and down continually. Patient's general health was good. There were two other children in the family living, one with chorea; and two had died of bronchitis. On examination the right eye was apparently healthy. The pupil of the left was irregularly dilated, there being numerous posterior synechiæ; from the outer part of the fundus was a white reflex. Tension normal. Glioma of the retina was diagnosed, and the eye removed the next day.

Pathological Examination.—The anterior chamber is very shallow on the inner side, the iris being almost in contact with cornea. The iris is adherent to the lens capsule in its whole extent. The lens is large, measuring antero-posteriorly 5 mm., transversely 7 mm.; there is some opacity of its outer part. The ciliary processes are very small. There is umbrella-shaped detachment of of the retina; at the lower and outer part where it is folded on itself it is thicker and denser than elsewhere. The choroid and optic nerve appear healthy. No microscopical examination was made.

Case 8 (*Register No.* 2162).—*Semi-organised fibrous tissue formation in vitreous and circumlental space. Retraction of root of iris and detachment of retina. History of fit a few days previous to eye affection.*

William C., aged 7 months, was admitted to the Moorfields Hospital on September 30, 1886. His mother stated that six or seven weeks ago he had had a fit, and for two or three days after took little notice of anything; since then he had been losing flesh. She first noticed something the matter with his right eye a few days after the fit; it was then blood-shot. It had only begun to "get small" last week. There had been no injury to the eye. There was no history of consumption in the family. She had two other children, both healthy. On examination, the tension of the right eye was found to be minus, the pupil small and slightly eccentric, and not quite clear. The iris was almost in contact with cornea at its pupillary margin, but somewhat retracted at its periphery, leaving there a shallow anterior chamber. No fundus reflex could be obtained. The eye was excised the same day.

Pathological Examination.—The iris is very intimately adherent to the lens capsule; it is retracted at its periphery, and then, bending sharply, follows the anterior surface of the lens. There is a projecting knob from the posterior pole of the lens into the shrunken vitreous. The retina is detached and folded into a fairly firm mass; it appears to be adherent to the posterior surface of the lens. It retains, by means of a narrow cord, its attachment to the optic disc. The sub-retinal space is filled by a material of a spongy consistence. The choroid is deeply pigmented and drawn inwards to a slight extent at the anterior part.

Microscopical Appearances.—An organised inflammatory membrane stretches across the pupil. There is adhesion of the pupillary border of the iris to the lens capsule on one side of the sections. The inflammatory membrane extends throughout between the posterior surface of the iris and the lens; it is merged at the root of the former with a mass of semi-organised fibrous tissue situated in the circumlental space. This is continuous again with structure of a similar character, in some places more highly developed than others, and with newly-

formed blood vessels in it, which stretches across the globe in the ciliary region, and which unites the posterior capsule of the lens to the detached and folded retina. This tissue appears to have resulted from inflammatory exudation into the vitreous, which has become partly organised into fibrous tissue, and by its contraction drawn back the root of the iris, caused the projection at the posterior pole of the lens, and detached the retina. The pars ciliaris retinæ is much thickened by cellular infiltration and proliferation. The uveal pigment of the ciliary body has, in one part, prolongations from it inwards, in the form of tubular processes. The retina is much infiltrated with cells, and the limit of its inner surface can scarcely be made out from the mass of cells in the shrunken vitreous; there are patches of pigmented cells in its substance. The ciliary body has several large nodules of round cells in it. The choroid shows hardly any changes; just at the margin of the optic nerve on each side there is some infiltration of it. The portion of the optic nerve left attached to the globe has marked hypernucleation; there are inflammatory products between its pial and dural sheaths.

Case 9 (*Register No.* 2361).—*Fibrous tissue formation in vitreous. Detachment of retina and retraction of root of iris. History of illness some months after eye affection first noticed. A younger brother similarly affected.*

Reginald A., aged $1\frac{1}{3}$, was admitted to the Moorfields Hospital on June 23, 1887. His mother said she noticed his right eye to be different from his left soon after he was born; he had "a cast in it." She had first noticed something in the pupil in March, 1886. In September the patient had a severe attack of sickness and diarrhœa; he was very ill for a week, and she thought he would not recover. He did not lose consciousness. He had never had measles or scarlet fever. He is her only child, and was born at full time. On examination, he was found to have lateral nystagmus of both eyes. There was a white reflex from behind the lens in the right, and the anterior chamber in it was very shallow. It was excised the following day. Three and a half years after the excision he died of diphtheria, having had good health in the meantime.

Pathological Examination of Eyeball.—It is small, concentrically shrunken. The iris is pushed forwards at its pupillary part. The lens is clear, and nearly globular in shape. There is an extensive, shallow detachment of the retina, it being much folded. Behind the lens is some opaque lymph adherent to its posterior capsule and to the retina. At the lower and outer part the choroid and retina are abnormally adherent, and there are several small hæmorrhages.

Microscopical Appearances.—No inflammatory cell infiltration of the uveal tract is seen, but there is considerable thickening of the uveal pigment. At the posterior part of the ciliary body there is some overgrowth of the uveal pigment in the form of tubes, which are seen cut both transversely and longitudinally. On the inner surface of the choroid there are several small hyaline masses, surrounded by uveal pigment. The detached retina, in which the fibrous tissue elements are much increased, also has some patches of pigment in it. Between the retina and lens is some fibrous tissue and some elongated cells. The optic nerve shows slight hypernucleation, and some increase of cells between its pial and dural sheaths.

On January 14, 1892, the mother of this patient brought her fourth child as an out-patient to Mr. Tweedy (Reginald was her first). He was then aged 4 months, and she stated he had a discharge from his eyes when he was first born. When about two months old he had been very feverish, and had whooping cough. He had always been very irritable, screaming a great deal, especially at night. He had never had any fits, or any discharge from the ears, or snuffles. At one time he had some spots on the skin of his arms and legs, but there are none now. In the right eye the anterior chamber was shallow, there was one posterior synechia, and the periphery of the iris seemed retracted; there was a yellow reflex with red lines on it behind the lens. In the left eye there was the same yellow reflex; the anterior chamber was shallower, being markedly shallower in the centre than at the periphery. The pupil was not so large as in the right eye, and there were more posterior synechiæ.

Her second and third children were alive and well, and had had no eye affection. She had had no miscarriages.

ROYAL LONDON OPHTHALMIC HOSPITAL

CASE 10 (*Register No.* 2783).—*Detachment of retina. Root of iris in contact with periphery of cornea. History of a fit and of a discharge from the ear.*

Victor K., aged $2\frac{3}{4}$, was admitted to the Moorfields Hospital on January 30th, 1889. His mother stated that when the patient was six months old he had a fit, and that his right eye turned inwards. For the last eight months she had noticed his right eye "gradually increasing in size." The child appeared quite healthy and showed no cerebral symptoms or paralysis.

In his right eye the pupil was dilated and had a very marked black margin to it. From behind the lens, which was clear, a yellowish-green mottled reflex was seen, with a hæmorrhage anterior to it. The tension was normal. It was doubtful if the child could tell light from dark with the eye or not. It was excised the next day.

He was seen again in February, 1892, and appeared then in good health. Questioned with regard to his ears, his mother said that, ever since he was a baby he had had a discharge on and off from the right, and that occasionally something seems to swell in it and break.

There were no signs of past neuritis in the left eye.

Pathological Examination.—The eyeball measured 21 mm. antero-posteriorly and 20 mm. laterally. The periphery of the iris is in contact with the posterior surface of the cornea, narrowing the angle of the anterior chamber. The vitreous is shrunken, and the retina detached from the optic disc up to the ora serrata. There is some gelatinous substance, with cholesterine crystals and the remains of old blood clot, between the detached retina and the choroid.

Microscopical Appearances.—The whole uveal tract is thin, but in no part of it is there any sign of inflammation. The iris is very thin; there is an abrupt bend in it a little distance from its root, where it ceases to be in contact with the cornea. The uveal pigment extends round its pupillary border and along its anterior surface for about half its extent. The sphincter muscle is tilted upwards at its pupillary border. The ciliary muscle is very much atrophied, and the ciliary processes pass inwards towards the margin of the lens almost at a right angle. The lens has cells lining the posterior capsule. The vitreous

shows a few elongated fibre cells in it in places. The detached retina has, throughout, increase of its fibrous tissue and diminution of its nervous elements; there are numerous scattered patches of pigment in it, and also irregular patches, which stain deeply with logwood, and in parts are slightly granular in structure, probably due to calcareous degeneration. On the inner surface of the elastic lamina of the choroid are several hyaline masses surrounded by pigment epithelium. This latter is in places thickened, and in others absent.

The optic nerve shows some hypernucleation and some increase of fibrous tissue; there are some round cells with deeply staining nuclei between its dural and pial sheaths. The lamina cribrosa is slightly curved backwards.

CASE 11 (*Register No.* 3344).—*Detachment of retina. Exudation into vitreous. No history of illness previous to eye affection.*

William F., a pasty-looking child, aged 3, was admitted to the Moorfields Hospital on February 19, 1891. His mother stated that about two months previously she had first noticed something "shining bright" in his left eye, and that this had gradually become more marked. He had had no previous illnesses, no fits, and no injury to the eye. He shows no signs of hereditary syphilis, and there was no family history of importance.

His right eye appeared normal. In his left, the lens was clear, and a mottled yellow reflex was seen behind it. Blood-vessels, probably retinal, were visible, and the sparkle of cholesterine crystals from behind them could be seen. Tension normal. The case was thought to be probably one of glioma of the retina, and the eye excised a week later.

Pathological Examination.—The anterior chamber is very shallow, the lens being pushed forwards. The vitreous is much shrunken. The retina is detached completely from the optic disc to the ora serrata; there is no new growth from it. Between the detached retina and the uveal pigment, is a fluid containing cholesterine crystals, and a white flocculent substance. Projecting from the inner surface of the uveal pigment layer, are three little masses about the size of hemp seeds,

one at the posterior part of the globe near the optic disc, and the other two a short distance behind the ora serrata. The outer surface of the detached retina has some white deposit on it.

Microscopical Appearances.—The ciliary body and iris in the sections examined are free from any cell infiltration. The latter appears thin, and the ciliary processes are atrophied. The choroid is also thin; there is some round cell infiltration of that portion of it which has the raised mass on its inner surface at the posterior part of the globe.

The lens appears healthy. The vitreous is much shrunken; there is some cell exudation into that part which is in contact with the inner surface of the detached retina. The retina has considerable diffuse, inflammatory cell infiltration throughout it; the chief accumulation of round cells is around its blood-vessels.

The raised masses mentioned above, on the inner surface of the choroid, consist of layers of a hyaline substance, with flattened cells between them, and collections of cells of irregular shape, with scattered pigment granules in them.

There are also in these masses, granules of pigment not contained in cells, and slit-like spaces which look as though they had contained crystals which have become dissolved out, probably cholesterine crystals. The elastic lamina appears to be situated on their outer surface, though it cannot be traced all the way in the sections.

The small portion of the optic nerve left attached to the globe has much infiltration of round cells between its bundles of nerve fibres, and between its pial and dural sheaths.

CASE 12 (*Register No.* 3516).—*Infiltration and new formation of blood vessels in vitreous. Detachment of retina. Root of iris partly in contact with cornea, partly retracted. Head symptoms. Loss of power in right arm and leg.*

William R., aged 9 months, was admitted to the Hospital for Sick Children, Aberdeen, under the care of Dr. Mackenzie Davidson on September 8, 1891. I am indebted to Dr. Davidson for the specimen, and for the notes of the case.

On admission, he had an enlargement of the right side of the scrotum, which was supposed to be a hernia, but which turned out to be a unilocular non-congenital hydrocele. His

mother stated that nothing was noticed the matter with his left eye until after he had a fit two days previously; then dimness came on, and the child complained of great photophobia and pain.

Upon examination, there was found to be acute iritis. A few days later he was noticed to be drowsy and irritable when touched. Sensation as far as could be made out was everywhere acute. The right arm, if used at all, which was very seldom, was never used from the shoulder; the grasp on that side was feeble. There was no wasting of the muscles of the arm, but generally the child was puny, feeble, and badly nourished. The reflexes were all present. Hearing was acute.

On September 25, the iritis was noted as being still active, though less marked. The iris was *bombé*, and T. +. There was a grey reflex from behind the lens. Apparently he had no perception of light with the eye. Drowsiness was still marked; he was very irritable, and cried a good deal. His right leg was thought not to kick so vigorously as the left. There was no sickness.

On October 2, the left eye was enucleated under chloroform.

On the 15th, the condition of the child was noted to have greatly improved; he was gaining flesh. He still used his right arm and leg less than the left. The hydrocele had disappeared without any special treatment.

The child was subsequently seen on November 6, 1891, and February, 1892; on both occasions he appeared quite well, had no head symptoms, and used the right arm and leg freely.

Pathological Examination.—The anterior chamber is shallow. The lens is *in situ*. The retina is completely detached, from the optic disc to the ora serrata. The vitreous is shrunken, infiltrated, and yellow. There is some disturbance of the pigment epithelium on the inner surface of the choroid.

Microscopical Appearances.—There are some small scattered patches of round-cell infiltration throughout the substance of the iris. A newly-formed membrane fills the pupil, which is attached to the lens capsule, and is continuous with a layer of inflammatory exudation which there is between the iris and lens; this joins exudation of a similar character in the circumlental space.

The angle of the anterior chamber is closed by adhesion of the root of the iris to the posterior surface of the cornea at its periphery. At the point where the iris ceases to be in contact with the cornea, it bends directly backwards, and there is an abrupt bend in it again forwards, where it comes in contact with the lens. The ciliary body has considerable round-cell exudation into it; there is considerable proliferation of its uveal pigment and of the elements of the pars ciliaris retinæ. The choroid has scattered nodules of round cells in it, and there is some enlargement of the lymph space between it and the sclerotic.

No division can be made out between the inner layers of the retina and the shrunken vitreous, which are adherent and both intensely infiltrated with round cells. In the masses of cells which infiltrate the vitreous, newly-formed blood-vessels starting from those of the retina are seen to pass. On the outer surface of the detached retina are patches composed of red blood corpuscles, scattered nucleated round cells, and uveal pigment cells.

Case 13 (*Register No.* 3550).—*Acute illness with head symptoms, followed by appearances in eye simulating glioma produced by exudation into vitreous. Death from meningitis thirty-nine days after excision. Middle ear disease.*

Elizabeth Amelia B. was admitted to the Moorfields Hospital on November 9, 1891. Her mother stated that the patient was born at full time; she was quite healthy at birth, but always pale. When 14 months old she had diarrhœa, got very thin, and was several times convulsed. A month later she was taken to the Shadwell Hospital, and said to have rickets. She never had any rash on the skin, or snuffles.

Six days ago patient was sick, felt hot, shivered a little, and was peculiar in her manner, wanting to lay her head back. Four days ago the mother first noticed anything wrong with her right eye; it was then blood-shot, and a day later she observed a white appearance in the pupil. The patient was then taken to Shadwell Hospital and had something dropped into the eye.

She is the fifth child of a family of six, two of whom died

of bronchitis. There is no history of phthisis in either the father's or mother's family.

On examination, the right eye was found to be prominent. The pupil was dilated; in its centre was a white opacity from which thin tags passed to the anterior surface of the iris. There was a whitish reflex from behind the lens; no fundus details could be seen. The tension was +1.

The eye was thought to contain a new growth, and was accordingly excised the same day. The evening temperature was 103·4°. The next day the following note was made: Child has probably meningitis in irritable stage; retraction of head; characteristic cry. Morning temperature, 102·4°; evening temperature, 102·8°.

On November 12th she was transferred to the Great Ormond Street Children's Hospital.

The following is the history of the case from the child's admission to the Great Ormond Street Children's Hospital, under the care of Dr. Cheadle, up to the time of death:—

Condition at time of admission, November 12, 1891. Retraction of head; legs drawn up. Face pale, flushes occasionally. Fontanelle wide, bulges, and pulsates. Signs of irritability; no paralysis. Pupil reacts to light and accommodation. Conjunctival reflex well marked; slight photophobia. No optic neuritis. Plantar reflex brisk. Knee-jerks absent, ? obtained once on left side. No ankle clonus. Pulse, 116; temperature, 102°, 103°, 99°.

November 17. Cervical opisthotonos more marked.

November 19. Ears were examined three days ago, and much inspissated material removed by syringing; no pus. Right membrane ? normal; left apparent membrane opaque and reddened. This morning right membrane crucially incised, and Politzer's bag used; clear mucus bubbled through opening. Abscess of left tympanic cavity demonstrated by Politzer's bag; granulation on inner wall of tympanum had been mistaken for membrane. Ears to be syringed with lot. hydrarg. perchlor. 1 in 5000 twice a day, and alembroth wool to be placed in meatus.

November 22. Vomiting. Respirations sighing. Constant fever.

December 1. Knee-jerks well marked; no *tache cerebrale*.

Retraction of head less; fontanelle not distended; child thinner; vomiting last few days.

December 14. Mr. Ballance trephined the left mastoid at 9.30 P.M. Pus was found in the mastoid cells, and also in the cranium between the dura mater and the temporal bone. There was no evidence of thrombosis of the lateral sinus. The cavity of the tympanum was opened, and some unhealthy granulations scraped out. A drainage tube was inserted, the ends coming through the wound and the external auditory meatus.

December 18. Several right-sided fits, beginning in face and spreading to a slight extent to left side. She rapidly sank, and died at 9 P.M.

Pathological Examination of Right Eyeball.—The white opacity seen in the pupil with fine tags passing to the anterior surface of the iris became free during the excision of the eye, and floated in the anterior chamber. The lens is apparently healthy. The vitreous has some yellow exudation into it; this is most extensive at its periphery, where it is in contact with the retina, the anterior part in contact with the lens being only slightly streaked. The retina is thickened, especially posteriorly; it has some rucks in it. The optic disc is swollen.

Microscopical Appearances.—The white opacity in the anterior chamber consists of round cells with dividing nuclei, supported in a delicate network of fibres. There is material of a similar nature in the circumlental space. There is a layer of round cells on the anterior surface of the iris, and some increase of cells in its substance. The vitreous shows extensive infiltration of its substance by round cells with dividing nuclei; they are more numerous in its peripheral parts than in its central. The pars ciliaris retinæ and nerve fibre layer of the retina are both swollen, and infiltrated with round cells; in the latter they are grouped especially around the blood-vessels. The optic papilla is swollen. The portion of the nerve left attached to the globe shows hypernucleation, and there is exudation between its pial and dural sheaths. The choroid in the sections examined shows no changes. In the posterior part of the ciliary body a nodule of round cells is seen.

Post-mortem Examination (made 60 hours after death by Dr. Arkle).—Weight 13½ lbs.; body emaciated; *rigor mortis*

passing off (weather cold); skull cap and wedge-shaped piece of occipital bone removed; skull cap only slightly adherent; fontanelle open. There is marked thickening of the arachnoid, especially at junction of brain and spinal cord; some excess of fluid in sub-arachnoid space; brain removed; it shows evident signs of chronic meningitis. The signs are most intense in the interpeduncular space, where there is a fair amount of firm, coherent, yellow lymph. This lymph surrounds the optic commissure, which is hid from view. The 3rd nerve is also surrounded, and three or four patches extend on to the pons. The inflammatory process has extended along the fissure of Sylvius on each side and up over the front of the corpus callosum, so that it reaches the vertex in the median line above, and rises on the cerebrum half way to the vertex from each side. It shows itself on the convolutions in many minute patches of firm, yellow, opaque lymph. The meninges are thickened and opaque, and there is an extensive, fine, but intense, capillary injection of the vessels. On section the grey substance has everywhere a very pink colour. The brain substance is fairly firm. The posterior cornua of the lateral ventricles are a little dilated, but, beyond slight injection of the 3rd ventricle, all is quite natural in appearance. The veins of Galen are patent. There is no tubercle anywhere.

The trephine opening reaches the dura mater in the anterior external angle, between the base of the petrous and squamous portions. There is no change in the inside of the dura mater at this spot. The lateral sinus is empty and healthy looking, and this hardly looks the focus of the inflammatory process. The arachnoid is thickened and injected as far as the cervical enlargement of the cord, but otherwise the cord is healthy. No tubercle can be seen anywhere. Thoracic organs removed. Heart and lungs quite healthy: no tubercle. Abdominal organs, liver, spleen, kidneys, and peritoneum quite healthy; no tubercle. Intestines and stomach normal; no tubercle anywhere.

Microscopical Appearances of the Optic Nerves and Commissure removed post mortem.—The membranes around the optic commissure have extensive round-cell exudation into them. There is also exudation around the blood vessels passing into it.

Sections of both optic nerves a little distance from the

commissure show excess of round cells between the pial and dural sheath, and hypernucleation of the nerve, most marked at its periphery.

Sections from about the middle of the right optic nerve show similar inflammatory changes, though less pronounced.

The stump of the right optic nerve, left in the orbit at the time of excision, has its divided end closed over by the turning in of the dural sheath. There is some atrophy of the nerve fibres and increase of fibrous tissue in this region. Further back the tissue around the central vessels appears œdematous, but there is only slight increase of cells in the space between its sheaths and in its tissue. The left optic disc and orbital portion of the nerve appear healthy.

CASE 14 (*Register No.* 3615). *Exudation and fibrous tissue formation in vitreous. Detachment of retina. Retraction of root of iris. History of discharge from ear three months previous to eye affection.*

Charles H., aged 10 months, was admitted to the Moorfields Hospital on February 9, 1892. His mother stated that two weeks previously she first noticed something wrong with his left eye. She describes it as being blood-shot, the pupil being small, and its looking like a fish's eye. Two months ago he had a rash on the skin of his arms, legs, and buttocks, and about three months ago a discharge from his right ear; there was a little lump in the neck on the right side about the same time. He had never had any fits, and was a healthy looking child. On examination, the pupil was found to be small. The root of the iris was markedly retracted, so that the anterior chamber at the periphery appeared deep, while in the centre it was shallow. There was a reddish reflex from the centre of the pupil, and a white reflex from below. The tension of the eye was minus.

Pathological Examination.—The iris and cornea are almost in contact in the centre, some little distance is left between them at the periphery. The lens is altered in shape, it has a small round nob projecting backwards from it at its posterior pole (Fig. 2). Immediately behind the lens, and adherent to its capsule, is the shrunken fibrous vitreous, with a patch

of yellow infiltration in it about the centre. It passes backwards as a yellow cord to the optic disc. The retina is detached

FIG. 2.—The lateral half of the eye in Case 14; it shows the anterior chamber shallow in the centre, deeper at the periphery, a projection backwards at the posterior pole of the lens, a shrunken vitreous, and detached retina.

from the optic disc to the ora serrata, but it is not everywhere in contact with the shrunken vitreous. Anteriorly it is much puckered.

Microscopical Appearances.—Between the detached retina and the posterior surface of the lens, and adherent to them, is a mass of irregular fibrous tissue and cells. The mass is most fibrous at its periphery, and most cellular at its centre. It passes forwards on each side into the circumlental space, and is adherent to the root of the iris. Backwards it is prolonged as a thin pedicle to the optic disc. The root of the iris and the ciliary body have small patches of round-cell infiltration in them. The elements of the pars ciliaris retinæ and uveal pigment of the ciliary body show extensive proliferation. The choroid appears thin, but only shows inflammatory infiltration at the margin of the optic disc. There is round-cell exudation into the nerve fibre layer of the retina, chiefly around the larger blood vessels. The rods and cones are much shrunken and degenerated. In the nerve fibre layer anteriorly are a few hæmorrhages. There is marked hypernucleation of the optic nerve, and exudation between its pial and dural sheaths.

CASE 15 (*Register No.* 3420).—*Glioma retinæ affecting both eyes, in one of which there has been perforation of the cornea and shrinking.*

Victor A., aged 1 year and 4 months, was admitted to the Moorfields Hospital, on June 4, 1891. The history given by his mother was as follows :—The child was born at full time, and

nothing was noticed the matter with his eyes until he was a month old; then she observed what she described as a hole in his left eye. Previous to this there had been no discharge from it. It afterwards became blood-shot, and gradually shrank. When the patient was 8 months old his right eye was first noticed to be defective. She took him to a hospital, and was told he had "glioma," but excision was not advised. There was no family history of any importance; patient was the youngest of twelve, ten of whom were living.

Upon examination, a vascular yellowish mass was seen behind the lens in the right eye, also some small floating bodies in the vitreous. The iris appeared vascular and discoloured; the pupil was eccentric, being displaced upwards and inwards, and having a marked black ring all round its pupillary border.

The left eye was shrunken, the cornea being small and semi-opaque. Both eyeballs were excised the following day.

Pathological Examination.—The right eye measures 21 mm. antero-posteriorly, 20·5 mm. laterally, and 20 mm. vertically. The anterior chamber is shallow, its angle being closed. The whole retina is detached, and involved in a new growth of a mottled-grey and white colour on section, with some streaks of hæmorrhage in it. The lens appear healthy; the growth is in contact with its posterior surface.

FIG. 3.—The lateral halves of the two eyes in Case 15. The left is much shrunken and full of gliomatous growth, the lens being absent. The right is of normal size; glioma involves the whole retina.

The left eye, much shrunken, measures only 12·5 mm. antero-posteriorly and laterally. The vertical diameter of the cornea is much diminished; it is thickened, as also is the sclerotic. The whole of the interior of the globe is filled by a grey substance; there is no lens in it.

Microscopical Appearances.—Right eye. The new growth is

composed of the characteristic round cells of glioma, nearly all nucleus; it has stained in the usual patchy way.

The whole retina appears involved, so that scarcely any of its normal tissue can be seen. The growth stops a little short of the lamina cribrosa; there is some hypernucleation of the nerve, which is probably inflammatory. The pars ciliaris retinæ is involved. There is no inflammatory exudation in any part of the uveal tract.

Left eye. The growth filling the globe resembles, in the character and arrangement of the cells, that in the right. It is typically gliomatous. There are changes in the choroid, indicative of past inflammation in it. The cornea is vascular, and neither Bowman's nor Descemet's membrane can be distinguished; it has evidently been perforated.